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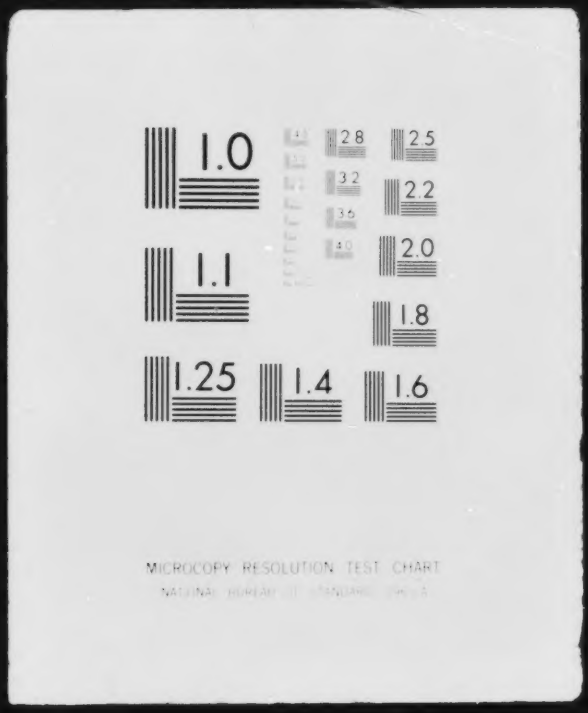
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ABSTRACT

The University of Minnesota's Math Anxiety Program consisted of four components: (1) the diagnostic clinic tested the participants' mathematical ability and level of math anxiety and provided an overview of the program; (2) three courses, from arithmetic to college algebra, with specially selected instructors were made available to the participants; (3) the support group provided opportunities for the participants to identify, discuss, and re-examine their attitudes toward mathematics; and (4) tutors provided additional help. Two background questionnaires, five anxiety scales, and one to two mathematics achievement tests were administered to the 71 participants in the diagnostic clinic. Results of the questionnaires, scales and tests are reported item-by-item. Comments regarding the students' experiences and attitudes and their parents' attitudes are included. It appears that mathematics anxiety is not isolated, but tends to be related to anxiety about tests or of negative evaluation. In general, the program was well received by the participants and judged to have favorable results. (CTM)

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The Math Anxiety Program: Its Genesis and Evaluation in Continuing Education for Women

Darwin D. Hendel

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1 Introduction

CHAPTER I

INTRODUCTION

Mathematics is part of everyday life. Yet, a sizeable percentage of the population is hindered from becoming competent in mathematics because of a high degree of mathematics anxiety (Lazarus, 1974). This mathematics anxiety prevents them from participating in those educational experiences which, if successfully completed, would improve their competence in mathematics.

Math anxiety and mathophobia are two terms used to describe a widespread and recently recognized phenomenon, the irrational fear of mathematics. We see its symptoms exhibited all around us -- by people who cannot balance their checkbooks or who can't add numbers without using their fingers. Math anxiety is more than incompetence in math, however. It is a lack of math skills coupled with an attitude which makes it difficult to develop and/or use such skills in an effective manner. Mathematics anxiety has been defined by Richardson and Suinn (1972) as ". . . involving feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems . . ." Although some studies have been conducted concerning how mathematics anxiety may develop (e.g., Ernest, 1976), relatively little research has been conducted concerning the relationships between mathematics anxiety and specific background experiences, between math anxiety and measures of general anxiety, or between math anxiety and mathematics ability. And although fear of mathematics is not limited to women and minorities, recent articles (e.g., Tobias, 1976) have suggested that mathematics anxiety is more likely to be a problem for such individuals. The problem is compounded for older women continuing their education in mid-career.

Women who are "math anxious" often avoid careers in accounting and economics and engineering and architecture. Possible explanations for this phenomena, especially concerning the development of mathematics anxiety in women, have been summarized by Maccoby and Jacklin (1974). A recent study by Fennema and Sherman (1977) concluded:

> The data do not support either the expectations that males are invariably superior in mathematics achievement and spatial visualization or the idea that differences between the sexes increase with age and/or mathematics difficulty. The fact that half of the groups of students enrolled in mathematics did not show sex-related differences on these two variables can probably be attributed to better control of mathematics background in this study than in previous ones. The sex-related differences were small and score distributions overlapped considerably. The pattern of differences in mathematics achievement, spatial visualization and affective variables strongly suggests the influence of socio-cultural factors. This study suggests that long accepted beliefs about the validity and importance of "sex differences" need re-examination in a variety of ways. These data certainly indicate that many females have as much mathematical potential as do many males. The generalized belief that females cannot do well in mathematics is not supported." (p. 69)

Although interventions to deal directly with math anxiety (e.g., modifications in mathematics curricula, the development of less threatening testing strategies, and counseling techniques such as behavior modification) have been mentioned in the literature, relatively little research concerning the usefulness of these techniques in alleviating mathematics anxiety has been conducted. Aiken's (1976) review of recent research concerning the effects of attitudes and other affective variables in learning mathematics illustrated programs which have been successful in reducing mathematics anxiety.

While programs for the treatment of math anxiety are being developed at several colleges and universities throughout the country, there is little understanding of the construct. There has been little empirical research concerning the causes of math anxiety and its effects on participation and achievement in mathematics curricula, or whether math anxiety is symptomatic

of general anxiety or anxiety specific to situations involving mathematics. Research contributing to the understanding of math anxiety is essential not only from a purely scientific point of view but also to provide theoretical and empirical bases for the design and evaluation of programs for its treatment.

Genesis of the Program

Attention was called to the problem by the chairperson of the Accounting Department and a professor in Economics, both of whom taught credit classes for Continuing Education for Women. They came to Continuing Education for Women to discuss the problem the women were having in their classes. The women were highly intelligent; many had college degrees or had successfully completed some college work. CEW began to investigate the problem by talking with students in the classes and doing research concerning problems women have with mathematics. CEW found that the term "math anxiety" had been coined and that its symptoms accurately described the reaction toward mathematics of some of the students in Continuing Education for Women. The symptoms included blocking out numbers, avoiding situations requiring the use of math, and not being able to remember simple computations. Above all it represented an attitude toward mathematics that had developed over a period of time. These attitudes may develop, in part, from traditional approaches to math education. Students who get lost at one point are usually lost from that point on. The effect generalizes so that a student regards herself/himself as "dumb in math" even though she/he may have been very successful to that point. Many participants in the program have reported having math instructors, particularly in high school, who embarrassed them in class, ignored the difficulties they were having, or who chalked their mistakes up as "par for the course for a girl."

The Planning Process

The planning process took place over a period of 10 months beginning December 1975, although an experimental noncredit class was offered in January 1976, entitled "Math Anxiety: Basic Math Review." Departments within the University of Minnesota involved in the planning included the School of Mathematics, General College, Continuing Education and Extension Counseling, the Student Counseling Bureau, the Department of Accounting, and the Measurement Services Center. General College, a college within the University that deals primarily with students not adequately prepared for college level work, was extremely responsive to our efforts. With their help CEW identified what courses, both credit and noncredit, should be developed as part of the program, what methods of instruction should be employed, and instructors especially gifted in dealing with students who have difficulty with mathematics.

After much discussion with several counselors about the psychological components of math anxiety, CEW identified a counselor from the Student Counseling Bureau who also works with students in the Institute of Technology. She has a strong background in mathematics and has had considerable experience in working with study skills, test anxiety, and women. Her background and interest were particularly suitable to the program.

Measurement Services Center, a department concerned with testing, program evaluation, and the evaluation of instruction, gave full support to the project. A research associate with a Ph. D. in psychology and a minor in mathematics, undertook the design of original instruments to be used in assessing math anxiety as well as those to be used in measuring the effectiveness of the program.

In June 1976 a grant from the Center for Educational Development at the University of Minnesota made it possible to initiate a major Math Anxiety Program. In September 1976 a Math Anxiety Program was offered through Continuing Education for Women to combat the problem of math anxiety and its effects. The program was designed in such a way that it would be valuable for people who wished to improve their math skills to pursue other courses, for employment and for daily use.

Information about the Math Anxiety Program was disseminated in a number of ways. One was through the quarterly bulletin for Continuing Education for Women, which is distributed to about 10,000 people. News releases and public service announcements on radio and television were helpful in reaching new audiences. A brochure describing the program was mailed to individuals requesting information as well as to students who had participated in the pilot programs, students enrolled in Accounting and Economics courses and to companies in downtown Minneapolis. Feature articles in the major papers in Minneapolis and St. Paul aided awareness of the program.

The Program

The Math Anxiety Program consisted of four components, each of which had a specific purpose. The four components were as follows:

-- Math Anxiety Diagnostic Clinic

-- Three Math Classes

-- Math Anxiety Support Group

-- Math Tutorial

The Math Anxiety Diagnostic Clinic tested the participants' math ability and level of math anxiety and provided an overview of the program.

Math classes for fall semester included: Arithmetic and Elementary Algebra, Intermediate Algebra (GC 1441), and College Algebra (Math 1111). Arithmetic and Elementary Algebra was a noncredit class for which credit could be received through testing. The class was based on individualized instruction combined with small group lecture and was taught by two instructors. Intermediate Algebra was a five credit class offered through General College and College Algebra was a five credit class offered through the School of Mathematics. The latter is a prerequisite for calculus and is necessary to obtain a business certificate and for dgreee programs in many of the social and behavioral sciences. Both credit classes could be audited. The most important aspect of the courses was the instructors selected to teach them. Through pilot projects CEW found that one of the single most important factors in a student's perseverance with a math course was the instructor -- his or her approachability, patience, and ability to relate subject matter in an easily comprehendable manner. CEW selected the instructors based primarily on these factors.

The Math Anxiety Support Group was offered concurrently with the math classes. Led by a counseling psychologist, it met once a week for seven weeks. It gave the participants an opportunity to identify, discuss, and re-examine the attitudes they had developed toward mathematics. It dealt with test anxiety, mechanisms for dealing with blocks in mathematics as well as ways of dealing assertively with math instructors.

The Math Tutorial was set up once a week for three hours at the same location. Students from all three classes could receive additional help with math skills during that time.

CHAPTER II

METHOD

The present chapter describes those methods which were used in implementing various aspects of the Math Anxiety Program (e.g., the Diagnostic Clinic and feedback to the participants) as well as procedures which were used in evaluating the effectiveness of various components of the Math Anxiety Program.

Diagnostic Clinic

The three-hour Diagnostic Clinic was held on September 8, 1976 at a convenient off-campus location (MacPhail Center) in downtown Minneapolis. Seventy-one individuals attended the three-hour session. The purposes of the Diagnostic Clinic were: 1) to provide an overall description of the Math Anxiety Program and, thereby, to encourage those attending to enroll in a course and the support group; 2) to introduce participants, in an informal way, to some of the research literature concerning math skills and math anxiety, especially those studies which concern math ability and math anxiety in women; 3) to provide participants with a comprehensive description of their level of math performance, to pinpoint strengths and weaknesses, and to diagnose aspects of math about which participants were particularly anxious; 4) to place participants in an appropriate math class if they wished to continue in the Math Anxiety Program; and 5) to generate research data which, when analyzed subsequent to the completion of the Program, would provide a comprehensive description of the possible geneses of math anxiety.

All those individuals connected with the Math Anxiety Program (the program coordinator and evaluator, the three instructors, and the support group counselor) attended the Diagnostic Clinic. The program coordinator

described the overall program and the evaluator was responsible for describing and administering the tests and questionnaires. The instructors and counselor were introduced by the coordinator and they then gave a brief description of their role in the program and their approaches to math instruction.

The instruments were administered in the following order: Sentence Completion Questionnaire (10 minutes), Arithmetic Placement Test (60 minutes), anxiety scales (30 minutes), and the Math Anxiety Program Background Questionnaire (30 minutes). The Arithmetic Placement Tests were scored during the Diagnostic Clinic; individuals who scored 48 or higher on the 68-item test were given another more advanced test, the Algebra Test, with instructions to complete it within the next couple of days and sent it to CEW.

More extensive feedback concerning her/his specific performance on the math tests was sent to each participant approximately 10 days after the Diagnostic Clinic. Appendix A contains a copy of this first feedback letter which was designed to assist in the selection of a math course. A second feedback letter was developed in March of 1977, partially as a result of participants' interest in wanting to receive additional test results, to provide feedback concerning their math anxiety. Appendix B contains a copy of this second letter.

Instruments

Tests and questionnaires were administered during the September Diagnostic Clinic and again the following February to asses the effectiveness of various aspects of the Math Anxiety Program.

General inventories. Two general questionnaires were developed to provide a comprehensive description of participants' past experience in math

and to describe how they felt about math. The first instrument, the Sentence Completion Questionnaire, consisted of 28 sentence stems of the type, "I did well in math until..." and required that participants complete the sentence in any manner they wished. The second instrument, the Math Anxiety Program Background Questionnaire, was a nine-page questionnaire which contained items concerning math background and current attitudes concerning math, among others. Both instruments were developed on the basis of hypotheses generated by previous research (Sells, 1973; Lazarus, 1974; Tobias, 1975; Ernest, 1976; Aiken, 1976) and by staff connected with the development and implementation of the Math Anxiety Program.

Anxiety scales. Five anxiety scales were administered during the Diagnostic Clinic. Although the psychological literature describes many general anxiety scales (e.g., the Taylor Manifest Anxiety Scale; Taylor, 1953), no such general measure was included in the present study because the content and purposes of such scales were not hypothesized to be directly relevant to the present study. Five specific anxiety scales which measured anxiety dimensions hypothesized to relate to math anxiety were included: the Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1973), the Suinn Test Anxiety Behavior Scale (STABS; Suinn, 1969), the Fear of Negative Evaluation Scale (Watson & Friend, 1968), and the Facilitating Anxiety Scale and a parallel Debilitating Anxiety Scale (Alpert & Haber, 1966). The number of items on each inventory is 99 items (each item is scored 1 - 5; range of total scores 94 - 470); 50 items (each item is scored 1 - 5; range of total scores 50 - 250); 30 items (each item is scored 0 or 1; range of total scores is 0 - 30); 9 items (each item is scored 1 - 5; range of total scores 9 - 45); and 10 items (each item is scored 1 - 5; range of total scores 10 - 50), respectively.

The major purpose for administering the five scales was to determine the interrelationships among anxiety scales, expecially relationships to previous math experiences. One anxiety scale, the MARS, was re-administered in February 1977 to determine changes in math anxiety. The MARS items varied extensively in content from "having someone watch you as you total up a column of figures" to "starting a new chapter in a math book." The initial MARS results were also used to set up a desensitization hierarchy which was used in the support group.

Mathematics tests. Two math tests were administered to some or all of the participants in the Diagnostic Clinic. Everybody completed the 68-item multiple choice Arithmetic Placement Test and those who scored 48 or above (a cut-off determined by the math instructors) were given the 50-item Algebra Placement Test. A total of 35 people completed the Algebra Test. The Arithmetic Test yielded a total score and scores for thirteen sub-scales, each of which covered a specific content area (e.g., Ratios, Rates and Proportions). The Algebra Test yielded one total score. These tests were designed from a combination of placement tests used in General College.

Participants who scored less than 48 points on the Arithmetic Placement Test were encouraged to enroll in Arithmetic and Elementary Algebra. Individuals who scored 12 - 30 points on the Algebra Test were encouraged to enroll in Intermediate Algebra (GC 1441) and those who scored more than 30 points were encouraged to enroll in College Algebra (Math 1111). These recommendations concerning course enrollment were communicated to the participants in the previously described first feedback letter.

The Arithmetic Placement Test was re-administered to those individuals who participated in the Diagnostic Clinic and subsequently enrolled in Arithmetic and Elementary Algebra. The test was re-administered to those

individuals to obtain an assessment of improvement in math performance resulting from participating in an appropriate course. (Although it would have been desirable for comparison purposes to re-administer the Arithmetic Test to all participants in the Diagnostic Clinic, the difficulty in motivating the individuals who did not take a course to complete the lengthy test precluded doing so).

Evaluation questionnaires. Three evaluation questionnaires were developed to assess participants' evaluation of the Diagnostic Clinic, the three math classes, and the support group.

All participants in the Diagnostic Clinic were sent a copy of the "Diagnostic Clinic Evaluation Questionnaire" which included questions about how the Diagnostic Clinic helped participants achieve their goals, reactions to each aspect of the Diagnostic Clinic, overall effectiveness of the Diagnostic Clinic, and suggestions concerning how the Diagnostic Clinic could be improved.

The second questionnaire, the "Course Evaluation Questionnaire," was sent to all students who enrolled in any of the three math classes. The questionnaire contained items concerning the extent to which the courses fulfilled their goals, a series of 16 specific items concerning various aspects of each of the courses, overall effectiveness of the course, and ways in which the course could be improved.

The "Support Group Evaluation Questionnaire" was sent to all individuals who attended the first session of the support group. This questionnaire was developed to obtain feedback concerning the effectiveness of the support group as a technique for helping individuals overcome their fears concerning mathematics.

Procedure

The initial testing in September occurred at MacPhail Center in downtown Minneapolis. Since in-person administration at follow-up was not feasible, the follow-up tests and questionnaires were sent to appropriate individuals (i.e., all participants received the MARS and the Diagnostic Clinic Evaluation questionnaire, those who were enrolled in a course also received the Course Evaluation Questionnaire, and those who participated in the support group received the Support Group Evaluation Questionnaire). The follow-up procedure began in February 1977, approximately 10 days after the conclusion of the fall semester.

Data Analysis

Descriptive statistics were calculated for all variables on each of the questionnaires. Scoring programs were developed for the five anxiety scales. The two math tests were hand scored.

Comparisons between two groups (e.g., course registrants versus non-registrants) used t-tests for independent samples and comparisons among three or more groups used one-way analysis of variance (ANOVA) procedures. Analysis of change scores on the MARS used t-tests for correlated data and one-way ANOVA's on pre and post scores.

Other statistical procedures (e.g., chi-square and Pearson product-moment correlations) were used to obtain information concerning relationships among variables on the various tests and questionnaires used in the present study.

The Diagnostic Clinic Background Questionnaire and the Sentence Completion Questionnaire contained open-ended questions. Responses to each question were read and each response was placed in a primary content

category for that question. Each person's response was placed in only one content category even if the response contained elements which could have been placed in other content categories.

"It is not sex-linked, but encouragement linked. I wasn't encouraged to take math because no one felt a drama teacher would need it -- who would guess I'd end up in the computer industry instead. My male peers were headed toward science careers, so they were encouraged to take math courses."

"I do not think men or women are inherently better than the other sex in any intellectual field. I think men are represented to a greater extent in the scientific fields because society encourages that image of male versus female roles and ability."

3 Diagnostic Clinic Results

CHAPTER III

DIAGNOSTIC CLINIC RESULTS

Participants in the Math Anxiety Program completed an extensive battery of tests and questionnaires during the half-day Diagnostic Clinic. The present chapter summarizes the results of data analyses performed for information collected during the Diagnostic Clinic. Results are discussed in terms of the following general categories: description of participants, participant's expectations concerning the Program, mathematics background of participants, recollections concerning math education, current math attitudes and activities, mathematics anxiety, and tested and perceived mathematics abilities.

Participants in the Diagnostic Clinic

Participants ranged in age from 19 years of age to 59 years of age; the mean age was 37.2 (SD = 9.91) with a mode of 27. Sixty-nine of the participants were females; they varied in educational background, as Table 1 indicates. The two largest groups of participants consisted of those who had completed some college (32.4%) or who had completed a four-year college degree (22.5%).

Less than half of the participants (N = 31 or 43.7%) had previously been enrolled in other courses offered through Continuing Education for Women (CEW). The other 31 individuals had completed an average of 2.8 courses in CEW, with a range of from one to nine courses and a mode of two courses. A larger percentage of participants had been enrolled previously in night school courses offered through Continuing Education and Extension (CEE); 47 participants (66.2%) indicated that they had been enrolled in from one to nine courses, with a mean of 3.3 and a mode of one CEE course. Fourteen (19.7%) of the students indicated that they were currently a regular day school student

Table 1

Educational Background of Participants

Level	N	%
Less than a high school diploma	3	4.2
High school diploma	8	11.3
Business or trade school	--	--
Some college	23	32.4
Two year college degree	3	4.2
Four year college degree	16	22.5
Some graduate school or professional school	5	7.0
Graduate degree or professional degree	3	4.2
No response	10	14.0

at the University; three were sophomores, two were juniors, three were seniors, one was a graduate student, and six were adult-specials.

Expectations Concerning the Program

Almost all (N = 69) of the participants in the Diagnostic Clinic had not previously participated in other math anxiety programs; the two participants who had, had been enrolled in a previous course offered through CEW.

Determining how participants in a new educational experience were informed of the existence of the new program is often helpful in better publicizing subsequent offerings of the program. Participants were asked to indicate how they found out about the Math Anxiety Program. Results indicated that the CEW Bulletin was the most likely source of information (N = 32 or 45.1%), followed by newspapers (N = 19 or 26.8%) and the Extension bulletin (N = 10 or 14.1%). Smaller percentages were accounted for by referals from CEE counselors (4.2%), friends (2.8%), and other individuals (7.0%).

Participants were also asked to describe as completely as possible why they enrolled in the Math Anxiety Program and to list three specific goals which they hoped to attain. This question was included for two reasons: 1) to describe the varied expectations of participants to determine congruence between their expectations and the objectives of the Program; and 2) to outline certain criteria which might be useful in evaluation at the end of the Program.

Appendix C lists participants' verbatim descriptions of why they were participating, together with the specific goals they hoped to achieve by the end of the Math Anxiety Program. The diversity in their goals and expectations is apparent to anyone who reads the comments. Participants' statements concerning goals were used to develop a series of goal statements which were presented to participants at the end of the Program. Those data are described in the next chapter of this report.

A similar question attempted to focus on participants' affective responses to participating in the Math Anxiety Program. The specific question posed to subjects was: "How did you feel about math when you entered the room today? What does participation mean to you?" Since this question involved two parts, participants' responses were examined separately for each part of the question.

Responses to the first portion of the question indicates that the most frequent response was "anxious, frightened and negative" (28.3%). Percentages accounted for by six other content categories were as follows: "inadequate" (6.5%), "I'm not the only one with anxiety" (10.9%), hopeful and determined" (13.0%), "calm and positive" (17.4%), and "others" (6.5%). To give a flavor for the nature of participants' comments, one representative response from each of the seven categories, in order, has been transcribed as follows:

> "I was quite anxious as I knew I had lost quite a bit of operational ability but wasn't sure how much."
>
> "I felt that I belonged back in first grade with dots, triangles and flashcards."
>
> "I thought I was alone in my poor knowledge of math but it was encouraging to see others who share the same fears and emotions over the inability to know and understand math."
>
> "I feel very enthusiastic right now about adding a good knowledge of math to my education ."
>
> "I look forward to this program. It is something I have chosen to do on my own -- no one is pressuring me. I am solely responsible for how well I do. I love to take advantage of all the new things being offered."
>
> "Relaxed about this clinic because I am not competing for a grade -- will not be graded on a transcript."
>
> "I almost didn't come at all. The program is a last resort and cry for help."

Participation in the Program meant somewhat different things to different people. Of the 51 participants who responded to this portion of the question, the most frequent response was "to improve my math skills" (41.2%). The three other content categories were "to find out where my weaknesses lie" (19.6%),

to gain confidence and overcome fears" (29.4%), and "to continue my education" (9.8%). Illustrative comments for each of the content categories are as follows:

> "I felt I could learn if I stick to it and am encouraged and understood. This is the only program I've heard of to be understood and helpful."
>
> "I hope participation in the program will provide me with an assessment of my math skills level and placement information."
>
> "I think participating in the program will add to my motivation and confidence and I think it has already encouraged me in that I can see I'm not the only one."
>
> "This is a chance to give me more flexibility in the courses I can take (i.e., science, econ., statistics)."

Mathematics Background

Several questions concerning mathematics background were included to obtain a comprehensive picture of the participants and to determine what relationships might exist among previous math experiences, math ability, and math anxiety. Questions concerning math education in high school and college and typical grades received in math courses were included in this portion of the questionnaire.

Many years had elapsed since participants had received any formal mathematics instruction. The number of years which had elapsed ranged from one to 40 years, with a mean of 18.6 years and a mode of 30 years. The number and percentage of subjects in each of four categories were as follows: 1-10 years (N = 21 or 30.4%), 11-20 years (N = 19 or 27.6%), 21-30 years (N = 24 or 34.6%), and 31-40 years (N = 5 or 7.0%). These data suggest that considerable time had passed since most of the participants had received any formal math education: 11 or more years had elapsed for over two-thirds of the participants.

Participants in the Diagnostic Clinic were asked to indicate how many semesters of math they had completed in grades 8 through 12. Table 2 contains the frequency and percentage of students who had completed from zero to eight

Table 2

High School Mathematics Background: Total
Number of Semesters of Mathematics by Group

Number of Semesters	Diagnostic Clinic (N = 71)				Support Group (N = 15)				Non-Support (N = 56)				Course Registrants (N = 29)				Non-Registrants (N = 42)			
	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD
			3.21	1.96			2.93	1.58			3.29	2.06			3.00	1.54			3.35	2.20
							t = -.61, p = .54								t = -.14, p = .89					
0	9	12.7			2	13.3			7	12.5			3	10.7			6	14.0		
1	6	8.5			2	13.3			4	7.1			3	10.7			3	7.0		
2	10	14.1			--	--			10	17.9			2	7.1			8	18.6		
3	8	11.3			2	13.3			6	10.7			5	17.9			3	7.0		
4	27	38.0			9	60.0			18	32.1			14	50.0			13	30.2		
5	--	--			--	--			--	--			--	--			--	--		
6	9	12.7			--	--			9	16.1			1	3.6			8	18.6		
7	--	--			--	--			--	--			--	--			--	--		
8	2	2.8			--	--			2	3.6			--	--			2	4.6		

semesters of math in high school. For example, nine participants (12.7%) had completed no high school math courses. The typical participant had completed four semesters of math.

Table 2 also contains similar statistics for support group participants and non-participants, and for participants who actually enrolled in fall semester courses in the Math Anxiety Program versus those participants in the Diagnostic Clinic who did not register for fall semester courses. Results of a comparison between high school math background of support group participants versus non-participants did not indicate any statistically significant difference between the two groups ($\bar{x}$ = 2.93 years versus $\bar{x}$ = 3.29 years respectively). A second analysis was performed to determine if course registrants differed from non-course registrants in their high school math background; results indicated no statistically significant difference between the two groups. Participants in the Diagnostic Clinic who enrolled in fall semester courses did not differ from those participants who did not enroll.

In addition to general information concerning amount of high school math instruction, it seemed desirable to obtain information concerning which specific courses (e.g., geometry) participants had completed while in high school. Table 3 contains the percentage of Diagnostic Clinic subjects who had completed each of eight different courses; for example 80.3% of the participants in the Diagnostic Clinic had completed first year algebra. The typical participant had completed both first year algebra and geometry but only one-fourth of the participants had completed second year algebra.

Table 3 contains similar statistics for support group participants versus non-participants, and for those who registered for fall semester math courses versus those who did not. Comparisons between those who participated in the support group versus those who did not suggest differences in terms of the percentages of participants who had completed various math courses in high

Table 3

High School Mathematics Background:
Specific Mathematics Courses Completed, by Group

Course	Diagnostic Clinic (N = 71)	Support Group (N = 15)	Non-Support Group (N = 56)	Course Registrants (N = 29)	Non-Registrants (N = 42)
General mathematics	31.0	20.0	33.9	31.0	31.0
Business Mathematics	7.0	6.7	7.1	10.3	4.8
First year algebra	80.3	86.7	78.6	82.8	78.6
Geometry	64.8	73.3	62.5	65.5	64.3
Second year algebra	25.4	6.7	30.4	20.7	28.6
Trigonometry	5.6	--	7.1	6.9	4.8
Solid geometry	2.8	--	3.6	3.4	2.4
Calculus	--	--	--	--	--

school. Chi-square analyses were performed between support group participants and non-participants for each of the eight courses to determine whether or not the two groups differed in their enrollment in specific high school math courses. None of the comparisons yielded statistically significant results ($p \leq .05$). A second analysis compared course registrants versus non-registrants in terms of their enrollment in each of the high school courses, but none of the comparisons yielded statistically significant results.

Information concerning the typical grade participants received in those high school math courses was also obtained. Table 4 contains the descriptive information for the participants in the Diagnostic Clinic and for the various sub-groups of students. For example, 11 participants (15.5%) indicated that they typically received an A. A chi-square comparison between support group participants versus non-participants indicated that the two groups were similar in terms of typical math grade received in high school ($\chi^2 = .96$, $p = .81$). A similar comparison for course registrants versus non-registrants also indicated no difference between these two groups ($\chi^2 = 4.10$, $p = .25$).

Approximately one-third (N = 23 or 32.4%) of the participants had completed a math course since they had graduated from high school. The number of courses completed by these 23 participants ranged from one to six, with a mean of 1.5 courses and a mode of one. These results suggest that some participants in the Diagnostic Clinic had had some post-high school exposure to math, although the majority of students had not received any formal instruction in math since high school.

A related question concerned participants' previous experiences in studying foreign language, based on the hypothesis that experiences and attitudes concerning the study of foreign languages might be related to math anxiety. To test that hypothesis, participants were asked to indicate the number of years of foreign language they had had in high school and college, and their

Table 4

Typical High School Mathematics Grade, by Group

Grade	Diagnostic Clinic (N = 71)		Support (N = 15)		Non-Support (N = 56)		Course Registrants (N = 29)		Non-Registrants (N = 42)	
	N	%	N	%	N	%	N	%	N	%
A	11	15.5	1	6.7	10	17.9	3	10.3	8	19.0
B	22	31.0	5	33.3	17	30.4	7	24.1	15	35.7
C	16	22.5	3	20.0	13	23.2	9	31.0	7	16.7
D	9	12.7	2	13.3	7	12.5	2	6.9	7	16.7
F	--	--	--	--	--	--	--	--	--	--
No Response	13	18.3	4	26.7	9	16.1	3	10.3	10	23.8

attitudes concerning studying and learning foreign languages.

Approximately one-third (N = 24 or 33.8%) of the participants had no foreign language in high school; 10 people (14.1%) had one year, 18 participants (25.4%) had two years, 12 students (16.9%) had three years, and 7 students (9.9%) had four years. Information concerning years of foreign language since high school indicated that about two-thirds (N = 46 or 64.8%) of the individuals had none since high school.

Participants' responses concerning their attitudes toward studying and learning foreign languages indicated a slightly positive attitude ($\bar{x}$ = 3.6, SD = 1.16). The frequency and percent in each response category were as follows: "very negative" (N = 4 or 5.6%), "negative" (N = 9 or 12.7%), "neutral" (N = 14 or 19.7%), "positive" (N = 26 or 36.6%), and "very positive" (N = 17 or 23.9%).

Correlations between these three foreign language variables and math anxiety did not indicate any statistically significant ($p \leq .05$) relationships between variables. The correlation between attitudes toward foreign language and math anxiety was the largest ($r = -.18$, $p = .07$) and suggests that future studies might wish to examine this hypothesis in more detail.

Recollections Concerning Math Education and Experiences

The participants in the Diagnostic Clinic of the Math Anxiety Program were asked to respond to a variety of questions concerning their recollections concerning grade school and high school math education, and the attitudes of their parents concerning math, among others. These questions were included to more fully explore the genesis of math anxiety, to generate hypotheses which might be tested more specifically in subsequent research studies, and to provide a comprehensive historical description of participants' perceptions concerning their experiences with mathematics and formal math education.

The first four questions asked participants to indicate which subject they liked most and liked least, in grade school and in high school. Table 5 indicates participants' responses; for example, four participants (5.6%) indicated that they liked mathematics most in grade school in contrast to five participants (7.0%) who said that they liked mathematics least in high school. Results indicated that mathematics was the least liked subject, and English was the most liked subject, in both grade school and high school. The lack of differences between the findings for grade school and those for high school suggests that whatever negative attitudes concerning mathematics were present, did not change in transition from grade school to high school. The retrospective nature of these data, together with the relatively large percentages of respondents who could not remember which subjects they liked and the large percentage of participants who did not respond to these four questions, preclude making any interpretations concerning precisely when negative attitudes concerning math developed.

Two other questions asked participants to provide a more comprehensive description concerning math education in grade school. The specific question was: "Please describe your experiences with and how you felt about, math in grade school. What was your math instruction like?" Participants' responses varied in terms of length, content, and vigor of response. Eight content categories emerged from an analysis of participants' comments. Those categories, together with the percentage of comments in each category, were as follows: "positive experience -- did well and good instruction" (38.0%), "did poorly -- poor instruction" (16.9%), "horrible experience, frightening and intimidating" (12.7%), "don't remember" (11.3%), "others" (8.5%), "we moved often, my learning was interrupted" (5.6%), "did well, despite poor instruction" (4.2%), and "did poorly, but had good instruction" (2.0%). Some illustrative comments transcribed from participants questionnaires are as follows:

Table 5

Participants' Preferences Concerning Subject Matter Content in Grade School and High School

Area	Grade School				High School			
	Liked Most		Liked Least		Liked Most		Liked Least	
	N	%	N	%	N	%	N	%
Mathematics	4	5.6	27	38.0	5	7.0	27	38.0
English	18	25.4	4	5.6	27	38.0	5	7.0
Science	2	2.8	13	18.3	2	2.8	9	12.7
Social Studies	5	7.0	5	7.0	9	12.7	9	12.7
Other	13	18.3	4	5.6	10	14.1	8	11.3
Cannot remember	11	15.5	13	18.3	6	8.5	4	5.6
No Response	18	25.4	5	7.0	12	16.9	9	12.7

"I have pleasant memories of teachers patience and good instruction. I also remember catching on fairly quickly and having no problems."

"Okay because I was successful but I felt (was probably told by parents and sisters) that my teachers were generally unqualified in their math ability."

"Math was difficult and I felt I did poorly but tried hard. The instruction was great."

"I felt trapped -- I had no math 2-4th grade because the teachers didn't like the new math. In 4th grade we got a sub who liked math and always yelled 'What are you trying to pull?' (to me) because I did very well."

The next question was identical to the immediately preceding one, with the exception that participants were asked to focus on their math education in high school. Percentages in each of eight content categories were as follows: "it was difficult for me and I always felt behind" (22.9%), "I had poor instructors" (20.0%), "enjoyed it, did well and had good instruction" (15.7%), "I hated it and dropped out" (11.4%), "I did well in algebra" (10.0%), "felt that math was for boys and girls in math were laughed at (10.0%), "I did well in geometry" (7.0%), and "others" (2.8%). Illustrative responses to this question are as follows:

"I had only one year, and it was a good experience for me. The instruction was very good and I felt good about being able to understand the math. Even though I did well, I remained fearful about tackling it further and ended my math education after one year."

"Algebra was a positive experience. One of the first in my life. I loved the way I felt -- positive! I knew I was good."

"As I began to slip behind I crammed frequently only for tests but kept getting farther behind and more anxious with math overall; friendly, but not too serious."

"Took it two weeks -- close to tears through the hour every day. Then the teacher said 'I know this has been boring review for all of you -- now we can really get going.' I dropped the class."

"I hated going to class. I was always afraid to ask a question because then all the attention focused on you. As a result just got further behind until I convinced myself I couldn't do it and then covered that by it 'doesn't matter anyway' attitude."

"Felt that math was for boys especially the non-general math. Came from a patriarchial background where it was expected that boys get

preference into careers and higher education, and women are cast into the domestic and nurturing role."

Informal experiences with math as a child (e.g., playing math games such as three dimensional checkers) have been hypothesized to relate to positive attitudes concerning math. As a rough test of that hypothesis, participants indicated whether they had played math games as a child. Twenty-two (31.0%) individuals indicated that they had done so; the activities which were listed most frequently were cards (24.2%), billiards (18.2%), checkers (18.2%), and "monopoly" (9.1%). Participants' responses to these questions seemed to indicate that, as a group, they did not have extensive informal experiences with math as children.

One hypothesis concerning the development of math anxiety, especially for women, relates to the modeling effect which parents have on their children's behaviors and attitudes. To explore this hypothesis, participants were asked to indicate who typically helped them with their homework and to describe their mother's and father's attitudes toward, and abilities in, math.

Table 6 contains participants' responses concerning who typically helped them with their homework in each of four major subject areas. Results indicated that 38.1% of the students received help with math, in comparison to 32.3% for English, 17.7% for science, and 21.0% for social studies. A higher percentage said that their fathers helped with math than said their mothers helped (12.7% and 8.5% respectively), whereas the reverse was true for English: a lower percentage of fathers than mothers helped (5.6% versus 19.7%). Although some trends were observed in these findings, results were not statistically significant at $p \leq .05$.

Two additional open-ended questions asked participants to describe their mother's attitude toward math and her ability to do math and then to describe their fathers on the same dimensions. Table 7 contains descriptions of

Table 6

Participants' Recollections Concerning Being Helped with Homework, by Subject Matter

Helper	Mathematics		English		Science		Social Studies	
	N	%	N	%	N	%	N	%
Mother	6	8.5	14	19.7	3	4.2	4	5.6
Father	9	12.7	4	5.6	6	8.5	4	5.6
Both Equally	7	9.9	3	4.2	3	2.8	5	7.0
Another Family Member	5	7.0	2	2.8	3	4.2	2	2.8
Nobody Helped	36	50.7	42	59.2	49	69.0	49	69.0
Cannot Remember	6	8.5	4	5.6	7	9.9	6	8.5
No Response	2	2.8	2	2.8	1	1.4	1	1.4

participants' responses; for example 28.6% of the participants said that their mothers had "positive attitudes and good abilities" in contrast to 36.8% who responded similarly for their fathers. Although there was a tendency for responses for mothers to differ from responses for fathers, the differences were neither large nor statistically significant. It might be possible, however, that parental attitudes varied more for individuals with extremely high math anxiety. Future studies may wish to examine the effects of parental attitudes for those individuals with extremely high math anxiety.

Participants' specific comments about their parents' attitudes and abilities in math indicated a richness in content which the content categories do not reveal. Several comments have been included in the present report to illustrate the diversity present in participants' comments:

> "She is not negative about it; it occurs to me that she lets my father handle bills, etc., and yet she has her own bank account (supplied by her own salary), manages her own travel expenses, etc. Appears to defer but manages ok."
>
> "Although mother worked as a bookkeeper for many years, she has a great fear of even simple calculating which when pressed she does quite well."
>
> "'Have dad help you -- he knows math better than I do' or 'I don't know that kind of math.' I don't know what her ability was -- I never was aware of her doing any other than grocery shopping and household buying for a family of 11 but dad handled all bills and balanced checkbooks."
>
> "My mother told me that math was unnecessary for girls and that I should take French instead. She told me about snagging a boyfriend when she was in high school by playing dumb in math and asking a guy she was interested in for help. Her attitude has since changed."
>
> "I'm really not sure of her attitude. She has ability to do basic math and is good at bookkeeping, record keeping, etc. I'm quite sure she isn't or has never been interested in adding to her basic skills."
>
> "Father worked with computers and taught math. Tutored almost all friends of family who had trouble with it. Very good at math and logic (degrees in math and philosophy). Thought math very important and tried to help me with it for quite a while. Considered math an 'art'. Didn't like the way it was taught in school."
>
> "He doesn't handle money or take care of checking account -- mother does. He is an artist and teacher and has a BA in philosophy and MA. I don't think he cares for math or numbers."

Table 7

Participants' Descriptions of their Mothers' and Fathers' Attitudes and Abilities in Math

Category	Mothers'		Fathers'	
	N	%	N	%
Positive attitude and good ability	20	28.6	25	36.8
Positive attitude and poor ability	6	8.6	8	11.8
Poor attitude and poor ability	4	5.7	8	11.8
Don't know attitude but good ability	7	10.0	14	20.6
Don't know attitude but poor ability	6	8.6	2	2.9
Math not for women	4	5.7	2	2.9
Average ability but no interest	4	5.7	3	4.4
Don't know attitude or ability	14	20.0	6	8.8

"He was very good, he studied long hours by correspondence and became the best as an electrician, he didn't think women needed math."

"I don't think he paid any more attention to it than necessary for minimal daily accounting."

Participants were then asked to answer the question, "What do you consider to be the most important factors which influenced your interest and aptitude for doing math." The majority of participants (62.1%) listed positive factors such as "my own desire to do well" (22.7%), "inherited ability in math" (10.6%), and "good teachers" (9.1%). In contrast, 37.8% listed negative factors which had influenced their interest and aptitude for math as follows: "poor teachers" (12.1%), "lack of understanding" (10.6%), "didn't think math was important" (6.1%), "poor parental attitudes" (5.4%), and "a bad experience in a math class" (4.5%).

Current Math Attitudes and Activities

Several questions dealt with participants' current attitudes concerning math, how individuals typically used math in their daily life, and how having "math anxiety" affected them. Table 8 contains descriptive statistics concerning average responses concerning each of eight attitudes toward math items such as "I consider....an unpleasant activity." Higher means indicate that participants endorsed the statement as being more true of themselves.

Results generally indicated that participants considered math as an opportunity to learn but did not endorse that doing math was an opportunity to be creative. Responses to the items were not as negative as might have been expected for a group of participants in a math anxiety program.

Comparisons between the sub-groups of participants (i.e., support group versus non-support group and course registrants versus non-registrants) were performed to determine differences between sub-groups. Table 7 also contains the means for each of the sub-groups and the results of statistical comparisons

Table 8

Participants' Attitudes Concerning Mathematics, by Group

Item[a]	Diagnostic Clinic		Support (N = 15)		Non-Support (N = 56)		Course Registrants (N = 29)		Non-Registrants (N = 28)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
I look forward to it	2.68	1.18	2.93	1.28	2.61	1.16	2.86	1.25	2.55	1.13
			$t = .95, p = .36$				$t = 1.11, p = .27$			
I consider it an opportunity to learn	4.03	.85	4.13	.64	4.00	.89	4.21	.56	3.90	.98
			$t = .54, p = .59$				$t = 1.49, p = .14$			
I consider it an obligation I must fulfill	2.89	1.32	2.60	1.40	2.96	1.29	2.41	1.24	3.21	1.28
			$t = .95, p = .34$				$t = -2.62, p = .01$			
I consider it an unpleasant task	2.47	1.14	2.07	1.07	2.57	1.14	2.11	.99	2.71	1.18
			$t = 1.48, p = .14$				$t = -2.25, p = .03$			
I consider it an opportunity to be creative	2.39	1.30	3.07	1.22	2.20	1.27	2.86	1.24	2.07	1.25
			$t = 2.35, p = .02$				$t = 2.56, p = .01$			
I dislike it intensely	2.23	1.23	1.93	1.14	2.30	1.25	1.89	1.93	2.45	1.31
			$t = -1.02, p = .31$				$t = -1.90, p = .06$			
I avoid it whenever I can	2.65	1.43	2.53	1.46	2.68	1.43	2.45	1.40	2.79	1.44
			$t = -.35, p = .72$				$t = -.98, p = .33$			
I regard it as a mystery	3.03	1.40	2.80	1.37	3.09	1.42	2.83	1.42	3.17	1.40
			$t = -.71, p = .48$				$t = -1.00, p = .32$			

[a]Response categories were: not true at all (coded 1), slightly true (coded 2), somewhat true (coded 3), very true (coded 4), and extremely true (coded 5).

between sub-groups. Comparisons between support group participants versus non-participants yielded statistically significant ($p \leq .05$) for one item "I consider math an opportunity to be creative." Those who participated in the support group were more likely to endorse the statement as being true of them than non-support group individuals. Comparisons between course registrants and non-registrants yielded statistically significant results ($p \leq .05$) for three of the eight items. Course registrants were less likely than non-registrants to consider math an obligation and to consider math an unpleasant task but were more likely than non-registrants to consider math an opportunity to be creative. These results seem to indicate that Diagnostic Clinic participants who enrolled in fall semester courses had more positive attitudes concerning math than those who did not enroll.

Participants described which aspects of math they used most in their daily lives. Results of the categorization of responses to the open-ended question indicated that, as one would expect, addition and subtraction (67.6% and 52.1%) were the aspects of math most commonly used. Other percentages were 22.5% for multiplication, 18.3% for division, 19.7% for percentages, and 8.5% for fractions. Another 49.3% of the comments also included miscellaneous general uses such as budgeting, checkbooks, and interpreting statistical data.

A related question asked participants to describe what areas of math were particular problem areas for them. Responses to this question were very different than responses to the immediately preceding question: relatively few people had problems with addition (9.9%). Other more commonly noted problem areas included fractions (29.6%), percentages (18.3%), word problems (11.3%), geometry (8.5%), and logic statistics (8.5%). The most frequently noted problem areas pertained to aspects of math which participants indicated that they used infrequently.

Because of the nature of typical participants in CEW courses, information concerning participants current experiences in relation to math seemed desirable. The first such question was: "If you have children, how would you describe their attitudes concerning math?" Although the majority (53.7%) of the 41 respondents to this question said that their children had positive attitudes concerning math, 12.2% said that their children were negative. Another 22.0% said that it varied among their children and another three participants responded that their children's attitudes were divided according to "traditional sex role expectations." In general, it seems as if the participants in the Diagnostic Clinic had more negative attitudes concerning math than they perceived their children as having.

The second question pertained to "modern math" and asked participants to describe what exposure to modern math they had and their attitudes concerning it. About half (46.4%) of the participants said that they had no exposure to modern math. Another 46.4% of the participants found modern math to be confusing and difficult and 7.2% had a positive reaction to their experiences with modern math.

Being anxious about math can have a variety of effects, ranging from occasional feelings of uneasiness to overwhelming anxiety which prevents a person from applying for a job which requires doing math. Participants were asked to respond to the following two-part question: "How have your feelings about math affected you? What, if anything, have you been prevented from doing?" Twenty-five participants responded to the first portion of the question and 60 individuals responded to the second part.

The most frequent response to the first portion of the question was "lack self-confidence and feel inadequate" (44.0%) and "feel frustrated and frightened (28.0%). Specific blocks posed by feelings of inadequacy included "being prevented from taking certain courses or getting a degree"

(40.0%), "not being able to do practical things (e.g., sewing) requiring math" (15.0%), "unable to pursue certain careers" (6.7%), and "stunted personal growth" (5.0%). Another seven participants (11.7%) indicated that they had not been prevented (because of their feelings about math) from doing something that they wanted to do. Illustrative comments from both parts of the question are as follows:

> "I am not confident, and consider myself a problem learner and a person of low intelligence. I refuse to play cards with friends and purposely try to stay away from situations where others might be aware of my handicap with math."
>
> "I always wanted to be a doctor or work in some science field. When it became apparent I couldn't handle the math I couldn't take the science courses either. My clutching at exams and the fear of failure also extended into every course I ever took."
>
> "Excellent question -- my bars could probably answer better than I. I have had to study and figure out for myself -- and with help -- many complicated math problems -- by doing budgets -- understand computer print-out and percentages -- which I still don't fully understand."
>
> "Nothing until now when I have to take statistics."
>
> "I have been thinking about working on my BS in Business for about a year but have always been discouraged by the fact that I would have to 'start at the bottom' with math in order to fulfill requirements."
>
> "I think my inability in computer sciences and economics has been affected by my negative attitude toward math and logic. Thus, my business career has been slowed."
>
> "Was terribly frustrated by the two classes I had to take for entrance to college of education. I worked hard and got C's. Am being and have been prevented from pursuing any math or science careers. My anxiety prevented me from feeling good about math <u>teaching</u> I was doing."

Participants also completed a 28-item Sentence Completion Questionnaire which was composed of a variety of items concerning participants' current attitudes towards math (e.g., "Doing math makes me feel...") as well as items concerning previous experiences in math (e.g., "My high school math teachers..."). Participants' responses to each of the 28 questions were transcribed from their questionnaires and response categories were developed for each of the questions. The number of response categories varied from

five to nine, depending upon the heterogeneity of participants' responses.

Table 9 contains each of the sentence items and the content categories for each stem, together with the frequency and percentage of respondents in each of the content categories. For example, in response to the sentence stem "Math is...", 10 participants (14.1%) responded "important" or some response virtually the same as important. The descriptive statistics contained in Table 9 present a comprehensive picture of how participants in the Diagnostic Clinic viewed math, math education, and mathematicians. If certain types of responses are seen as being contributory to math anxiety, these summary data could be helpful to those implementing specific aspects of the Math Anxiety Program (e.g., the support group).

Additional analyses were performed to compare participants' responses to these 28 items with their scores on the Math Anxiety Rating Scale and the Arithmetic Test: Significant relationships (χ^2 analyses) between response categories and the MARS (low, medium, and high scale score categories were developed) were found for 11 or the 28 items (items 2, 6, 7, 10, 12, 14, 16, 18, 20, and 26). Significant chi-square values were obtained for 6 items between response categories and low, medium, and high categories on the arithmetic test (items 2, 7, 16, 18, 21, and 28). These results seem to indicate that many of the 28 items do not relate directly to math anxiety, as measured by the MARS, and may be excluded from future administrations of the Sentence Completion Questionnaire.

Mathematics Anxiety

The math Anxiety Program was designed for individuals who have math anxiety and/or are unable to do well in typical math courses. An important component of the Diagnostic Clinic was the measurement of math anxiety and related dimensions of anxiety. Although the psychological literature

Table 9

Participants' Responses to Sentence Completion Questionnaire, by Question

Question / Response Category		N	%
1. Math is...			
Important	71	10	14.1
Necessary		10	14.1
Interesting & fun, a challenge		11	15.5
Confusing & difficult, beyond comprehension		16	22.5
Frightening and intimidating		8	11.3
Something I had a negative experience with and dislike		6	8.5
Other		10	14.1
2. When I hear someone say "Math is fun" I...	71		
Don't believe them		7	9.9
Wonder what kind of people they are		3	4.2
Smile, laugh, crinkle my nose		7	9.9
Am envious		12	16.9
Agree		16	22.5
Wish I felt the same way		11	15.5
Am happy for them, but don't agree		8	11.3
Other		7	9.9
3. People who are good at math...	71		
Are generally intelligent		15	21.1
Have developed skills, either by self or were encouraged		12	16.9
Are logical people		5	7.0
Have more choices in the job market		6	8.5
Are lucky		9	12.7
Are admirable and I am envious		14	19.7
Make me feel inferior		3	4.2
Other		7	9.9
4. Doing math makes me feel...	70		
Confident and good when I know what I'm doing		11	15.7
Good		17	24.3
Frustrated and confused		20	28.6
Nervous, tired, ill		18	25.7
Other		4	5.7
5. I am anxious about math because...	71		
I don't understand it and do poorly at it		29	40.8
It's been years since I've used it		11	15.5
I had a bad experience with it		4	5.6
I'm afraid of it, it frustrates me		7	9.9
It's important to me educationally, professionally and for my self image		10	14.1
I like it, I'm not anxious about it		2	2.8
Other		8	11.3
6. I haven't done math since...	68		
High School		26	38.2
Jr. High		5	7.4
My post high school course work		10	14.7
I use it everyday		16	23.5
I balanced my checkbook		6	8.8
Other		5	7.4
7. My background in math is...	69		
Good or fair		5	7.2
Poor or weak		31	44.9
Limited		7	10.1
Forgotten		5	7.2
High School level		15	21.7
Some college or business school courses		6	8.7

-- Table 9 continued --

— Table 9 continued —

Question Response Category		N	%
8. My ability to do math is...	70		
Good, better than average		13	18.6
Average or basic		11	15.7
Limited		7	10.0
Poor or worse		25	35.7
Not developed		9	12.9
Unknown		5	7.1
9. When it comes to doing Math I find it difficult to...	71		
Relax and concentrate		17	23.9
Get interested and started		6	8.5
Think logically		8	11.3
Comprehend anything beyond the basics		9	12.7
Remember what I've learned and think quickly		12	16.9
Grasp concepts		5	7.0
Work with fractions, decimals or word problems		10	14.1
Other		4	5.6
10. If I were better at math I would...	69		
Feel better about myself		20	29.0
Feel more confident about my work		6	8.7
Enjoy and like it more		3	4.3
Take courses I've avoided		20	29.0
Major in a field I've avoided		7	10.1
Use it to get a job or a better job		7	10.1
Other		6	8.7
11. I want to become better at math so that I...	71		
To improve my self image, overcome my anxiety and become confident		31	43.7
So I can use it on a practical level		6	8.5
So I can use it in my job		6	8.5
To have a wider range of career choices		13	18.3
To have a wider range of course choices		4	5.6
To fulfill a specific course need		11	15.5
12. My motivation to do math is...	69		
Not strong		8	11.6
To increase my self-confidence and self-esteem		20	29.0
Strong and good		15	21.7
That it's needed for further education		14	20.3
Job related		8	11.6
Other		4	5.8
13. When I got bad grades in math...	69		
I was frustrated and discouraged		8	11.6
I was disappointed and upset		13	18.8
I felt embarrassed and inadequate		12	17.4
I began to dislike and avoid Math		2	2.9
I was not surprised		6	8.7
It was due to carelessness and lack of studying		9	13.0
It left no impression		6	8.7
Never had bad grades		4	5.8
Other		9	13.0
14. My most negative experience with math was when...	65		
I was called upon to demonstrate my ability, or lack of it, to others		4	6.2
My general ability was tested (ACT, GRE)		6	9.2
I had a problem with a particular or new concept		5	7.7
I got a bad grade in class		7	10.8
I had a poor teacher		10	15.4
I took algebra		18	27.7
I took geometry		5	7.7
I used it for practical reasons		8	12.3
Other		2	3.1

--Table 9 continued —

— Table 9 continued —

Question Response Category		N	%
15. I did well in math until...	69		
I needed more than memory		5	7.2
I tried to use it practically		3	4.3
I changed schools or had a class conflict		4	5.8
Algebra		17	24.6
Geometry		7	10.1
Jr. High		2	2.9
Elementary		13	18.8
I never did well		11	15.9
Other		7	10.1
16. I liked math until...	71		
It got difficult, I did poorly		16	22.5
Algebra		11	15.5
High School		10	14.1
Jr. High		4	5.6
Elementary		9	12.7
I never liked Math		13	18.3
Always liked it		5	7.0
Other		3	4.2
17. When I got good grades in math...	67		
I expected them		3	4.5
I had worked for them		7	10.4
I felt good and was pleased		35	52.2
I never got good grades		12	17.9
Other		10	14.9
18. My most positive experience with math was...	67		
A job related experience		11	16.4
Through practical application		7	10.4
When I mastered a concept and did well in class		13	19.4
Doing well in algebra		8	11.9
Doing well in geometry		6	9.0
In Jr. High		5	7.5
In elementary		12	17.9
I've never had a positive experience		5	7.5
19. When it was time for math in grade school I...	68		
Became ill or nervous		10	14.7
Disliked it or tuned myself out		9	13.2
Tried to do the best I could		6	8.8
Was glad, I enjoyed and liked it		15	22.1
Did well		11	16.2
Was not interested or had no reaction		12	17.6
Other		5	7.4
20. My grade school math teachers...	67		
Were incompetent or poor		12	17.9
Were frightening or humiliating		3	4.5
Didn't stress Math, also taught other subjects		4	6.0
Were good or average		22	32.8
Were excellent, patient and encouraging		10	14.9
I don't recall		8	11.9
Other		8	11.9
21. My father felt math was...	69		
Unimportant for females		10	14.5
Only for males		2	2.9
Important and necessary		26	37.7
Easy and fun		11	15.9
Difficult, he had low skills		6	8.7
No reaction or it was OK		11	15.9
Other		3	4.3

— Table 9 continued —

— Table 9 continued —

Question Response Category		N	%
22. My mother felt math was...	68		
Unimportant for a female		9	13.2
Only for males		2	2.9
Important and necessary		26	38.2
Easy and fun		9	13.2
Difficult, she had low skills		7	10.3
No reaction		9	13.2
Other		6	8.8
23. When it was time for math in high school I...	68		
Became ill or nervous		12	17.6
Found help to the point of cheating		4	5.9
Took only what was required		12	17.6
Avoided it, put it off until later		8	11.8
Did poorly		7	10.3
Did alright depending on type of class		5	7.4
Enjoyed and liked it		14	20.6
Other		6	8.8
24. My high school math teachers...	65		
Were incompetent, nonsupportive and impatient		12	18.5
Caused fear, were hard		3	4.6
Were more concerned with students' personality and sex		5	7.7
Were concerned with other interests		3	4.6
Were alright or good		11	16.9
Were stimulating, encouraging and patient		9	13.8
Left no impression or varied according to type of class		12	18.5
No High School Math		3	4.6
Other		7	10.8
25. When it comes to math boys are...	70		
Expected and encouraged to do better		18	25.7
Better than girls		22	31.4
More interested and confident		8	11.4
Equal to girls		17	24.3
Other		5	7.1
26. When it comes to math girls are...	68		
Not encouraged or expected to do well		9	13.2
Discriminated against		11	16.2
Anxious, less interested		8	11.8
Thought of as less capable		13	19.1
Equal to boys		17	25.0
Other		10	14.7
27. Male mathematicians are...	60		
Expected, normal		8	13.3
Intelligent, precise		14	23.3
Admirable, great		7	11.7
Okay		5	8.3
Introverted, boring boastful		11	18.3
No different than females		3	5.0
Other		12	20.0
28. Female mathematicians are...	66		
Admirable, great, inspiring		15	22.7
Intelligent and logical		10	15.2
Superior in math skills, more interested		3	4.5
Fortunate to have been encouraged in the past		3	4.5
Equal to everyone else, okay		10	15.2
Rare		8	12.1
Frightening intimidating		3	4.5
Cold, machine like		4	6.1
Other		10	15.2

describes many general anxiety measures (e.g., Taylor's Manifest Anxiety Scale), no such general measure of anxiety was included in the present study because the nature and content of such scales did not seem directly relevant to the present study. Five specific anxiety scales which measured anxiety components directly relevant to the Math Anxiety Program were included: the Mathematics Anxiety Rating Scale (MARS), the Suinn Test Anxiety Behavior Scale (STABS), a Fear of Negative Evaluation Scale, a Facilitating Anxiety Scale, and a Debilitating Anxiety Scale.

Table 10 contains the five anxiety scale means for the total group of participants in the Diagnostic Clinic and compares scale means for support group participants versus non-participants and course registrants versus non-registrants. For example, the mean MARS score was 253.89 for the total group of participants in the Diagnostic Clinic.

Comparisons between data contained in Table 10 and normative data for the MARS indicated that the present group of subjects scored considerably higher than other general groups of subjects described in the literature ($\bar{x}$ = 187.3 and SD = 55.5 for 119 students at Colorado State and $\bar{x}$ = 215.4 and SD = 65.3 for 397 students at the University of Missouri). These results seem to indicate that, in terms of measured math anxiety, participants in the Diagnostic Clinic were, as a group, very anxious about math.

Normative information was available for the other four scales also but did not indicate that participants in the Diagnostic Clinic had higher mean scores than other general groups of subjects. For example, a group of 75 students at the University of Hawaii had an average score of 145.8 on the STABS. These results seem to indicate that participants in the Diagnostic Clinic did not have extremely high levels of test anxiety, anxiety concerning being evaluated, nor were they likely to be high in terms of either facilitating or debilitating anxiety.

Table 10

Participants' Scores on Anxiety Scales

Scale	Total Participants			Support			Non-Support			Registrants			Non-Registrants		
	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD
MARS	70	253.89	63.89	15	268.60	65.85	55	249.87	63.37	29	251.83	69.74	211	253.34	60.27
					$t = 1.01, p = .32$						$t = -.23, p = .82$				
STABS	69	148.44	39.10	15	155.80	39.81	54	146.39	39.03	28	145.86	42.10	41	150.20	37.35
					$t = .82, p = .41$						$t = -.45, p = .65$				
Fear of Evaluation	66	15.80	6.79	14	14.79	4.85	52	16.08	7.24	27	15.33	6.30	39	16.13	7.18
					$t = -.13, p = .53$						$t = -.46, p = .64$				
Facilitating	65	21.91	6.04	14	21.50	4.72	51	22.02	6.40	26	22.19	6.32	39	21.72	5.93
					$t = -.28, p = .78$						$t = .31, p = .76$				
Debilitating	65	29.80	7.81	14	31.64	8.37	51	29.29	7.66	26	30.35	7.61	39	29.44	8.02
					$t = 1.00, p = .32$						$t = .46, p = .65$				

Table 10 also contains the results of comparisons between support group participants and non-participants for each of the five anxiety scales. Although there was a tendency for support group participants to have higher math and test anxiety scores, the differences between the two groups were not statistically significant at $p \leq .05$. None of the differences between the two groups were significant for any of the other three anxiety scales. None of the comparisons between course registrants versus non-registrants yielded results which were statistically significant at $p \leq .05$. Participants in the Diagnostic Clinic who enrolled in one of the three math courses did not differ from participants who did not enroll in courses in terms of initial level of anxiety. The hypothesis that participants with high (or low) anxiety did not enroll in math courses must be rejected.

Scores on the five anxiety scales were correlated with number of semesters of math the individuals had completed in high school. The obtained correlation was $-.30$ ($p \leq .01$) which suggested that individuals who had taken less math in high school had higher levels of math anxiety and vice versa. The results, together with responses to several open-questions, seem to indicate that experiences with math in high school are crucial in the development of math anxiety.

Although both age and years since last formal math instruction were negatively correlated with Arithmetic test score ($r = 22$, $p \leq .05$, and $r = -.30$, $p \leq .01$), neither of these two variables were significantly correlated with any of the five anxiety scales. Older participants in the Diagnostic Clinic did not tend to have either higher or lower math anxiety scores than younger participants.

Correlations between scale scores on each of the five anxiety scales were calculated to determine the relationships among the various variables. (The

higher the correlation, the stronger the relationship between the two scales.) Table 11 contains the results of those analyses and indicates that, without exception, all correlations between pairs of scales were highly significant. The correlation which was the largest was .65, for the correlation between math anxiety and test anxiety, and .65 for correlation between test anxiety and debilitating anxiety (which is heavily loaded with items pertaining to maladaptive test performance dimensions). The correlations between the MARS and the Fear of Negative Evaluation scale indicates that individuals who have high math anxiety are also anxious about being negatively evaluated and vice versa. What these results indicate is that being anxious about math is related to being anxious about tests and about being anxious about being evaluated. Math anxiety probably involves several components, the most important of which is being anxious about math, and is related to how anxious an individual feels about other educationally relevant experiences.

Another series of correlational analyses were performed to relate the five anxiety scales to participants' responses to the eight attitude items (e.g., I dislike math intensely). Table 12 contains the intercorrelations between anxiety scales and attitude items; 25 of the 40 correlations yielded statistically significant results. Six of the eight attitude items yielded significant correlations with the MARS: the item which had the strongest relationship was "I avoid math whenever I can;" this item could serve as a useful quick way to estimate an individual's math anxiety if not enough time to administer the MARS is available. In general, the correlations between attitude items and test anxiety were lower than the correlations between attitude items and math anxiety. Few of the correlations were significant for the second, third, and fifth items; these results indicate that these items do not significantly relate to anxiety and probably should not be included on future questionnaires.

Table 11

Correlations Among Anxiety Scale Scores

Scale	MARS	STABS	Fear of Evaluation	Facilitating	Debilitating
Math Anxiety	1.00				
Test Anxiety (STABS)	.65***	1.00			
Fear of Evaluation	.48***	.48***	1.00		
Facilitating	-.32**	-.41***	- .31**	1.00	
Debilitating	.47***	.65***	.40***	- .58***	1.00

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

Table 12

Intercorrelations Among Attitudes Toward Math and Anxiety Scale Scores

Item	Scales				
	Math Anxiety	Test Anxiety	Fear of Negative Evaluation	Facilitating Anxiety	Debilitating Anxiety
I look forward to math	-.39***	-.20	-.23*	.36**	-.22*
I consider math an opportunity to learn	-.24*	-.15	-.12	.09	-.14
I consider math an obligation I must fulfill	.05	.32**	.13	-.14	.03
I consider math an unpleasant task	.39***	.32**	.28**	-.30**	.30**
I consider math an opporutnity to be creative	-.12	-.08	-.11	.11	-.02
I dislike math intensely	.50***	.28*	.29**	-.34**	.32**
I avoid math whenever I can	.57***	.27*	.30**	-.29**	.27**
I regard math as a mystery	.45***	.30**	.14	-.08	.20*

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

Tested and Perceived Mathematics Abilities

The Diagnostic Clinic included several instruments and self-assessment techniques to obtain a description of individuals' abilities in math and their perceptions of their mathematics and related abilities, such as spatial and verbal abilities. These instruments and self-assessment techniques were included for several reasons: 1) to assist students in selecting one of the three math courses; 2) to provide the instructors with diagnostic information concerning participants' strong and weak areas in mathematics; and 3) to relate math abilities to other variables (e.g., attitudes and math anxiety) and to explore other hypotheses suggested by the literature (e.g., that individuals who are poor in math have low spatial ability).

Participants indicated which of the three math courses they thought was most appropriate for them. Results of this question indicated that 43 participants (60.6%) thought "Arithmetic and Elementary Algebra" was most appropriate, 18 participants (25.4%) selected "Intermediate Algebra" and seven participants (9.9%) selected "College Algebra and Analytic Geometry."

The arithmetic test consisted of 68 items and the algebra test consisted of 50 items. Table 13 contains a description of average scores of participants in the Diagnostic Clinic, of support group participants and non-participants, and of course registrants versus non-registrants for the total arithmetic test and for the total algebra test. The table also contains sub-scores for each of the total components of the arithmetic test for the total group of participants in the Diagnostic Clinic.

As the data in Table 13 indicate, the mean score for the total group was 46.0 (out of a possible total of 68 points); participants, as a group, answered correctly about 70% of the items on the arithmetic test. Sub-score means indicated that participants did less well in certain areas than

Table 13

Participants' Scores on Mathematics and Algebra Tests, by Group

Scale[a]	Diagnostic Clinic (N = 27)		Support Group			Non-Support			Course Registrants			Non Course Registrants		
	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD
Arithmetic Total	46.00	13.74	15	43.27	10.87	55	46.73	14.40	29	45.21	12.48	42	46.55	14.54
				$t = -.87$, $p = .39$						$t = -.40$, $p = .69$				
Addition and Subtraction of Whole Numbers (4, 92%)	3.69	.55												
Multiplication of Whole Numbers (4, 87%)	3.49	.68												
Addition and Subtraction of Decimals (4,83%)	3.30	.89												
Division of Whole Numbers (5, 54%)	2.70	1.18												
Meaning of Fractions and Rational Numbers (6, 75%)	4.49	1.46												
Multiplication and Division of Decimals (6, 74%)	4.41	1.64												
Problem Solving (6, 59%)	3.54	1.73												
Ratios, Rates, and Proportions (6, 60%)	3.97	1.50												
Meaning of Decimals (5, 88%)	4.40	.87												
Addition and Subtraction of Rational Numbers 7, 70%)	4.93	1.75												
Multiplication and Division of Rational Numbers (5, 65%)	3.27	1.32												
Properties of Numbers (6, 55%)	3.29	1.74												
Percentages (4, 77%)	3.07	.96												
Algebra Total	23.58	11.63	5	17.60	16.12	28	24.64	10.68	11	23.00	16.70	22	23.86	8.55
				$t = -1.26$, $p = .22$						$t = -.20$, $p = .84$				

[a]Number in parenthesis refers to number of items on the scale.

others; for example, the mean for items in the "Division of Whole-Numbers" category was 54% correct, in comparison to 87% for "Multiplication of Whole Numbers" items. These findings are generally parallel to previously reported findings concerning which areas of math were problematic for the participants. Individuals seemed to perform quite well for the basic areas of arithmetic, but this performance was not equally good in areas such as problem solving and operations with fractions and decimals.

Not all individuals completed the Algebra test; participants in the Diagnostic Clinic had to score 48 or greater on the Arithmetic test to be required to take the Algebra test. The mean score for the Algebra test was 23.6, or approximately 50% of the answers, on the average, being answered correctly by the 32 individuals who took the Algebra test.

One question of interest was whether or not support group participants differed from non-participants in terms of math ability and whether or not course registrants differed from non-registrants. Table 13 contains the results of comparisons between pairs of groups. Although support group participants and course registrants had slightly higher means for the Arithmetic and Algebra tests, none of the differences were statistically significant. Individuals who participated in the Diagnostic Clinic and registered for a course did not perform less well than those participants who did not register for a course.

In addition to examining arithmetic and algebra test scores for the total group of course registrants, additional analyses could have been performed to describe average scores for those participants who enrolled in each of the three courses. However, because of the small number of participants in the Diagnostic Clinic who enrolled in Intermediate Algebra and College Algebra, statistical analyses did not yield meaningful results.

Previous research has tended to indicate negative correlations between math performance and math anxiety. Results of correlational analyses between the Arithmetic and Algebra tests and each of the five anxiety scales, contained in Table 14, supported previous findings. Our results indicated a moderate negative correlation (-.53) between the Arithmetic score and MARS score and a moderate positive correlation (.53) between the Arithmetic score and Facilitating anxiety. Somewhat smaller correlations were found for the Fear of Negative Evaluation and Debilitating anxiety scales. The lowest significant correlation was between the Arithmetic score and test anxiety. Results of correlations for those participants who completed the Algebra test also yielded statistically significant results, although the magnitude of the correlations was considerably smaller.

Previous results have indicated that Diagnostic Clinic participants perceived that certain areas of math were difficult for them and in fact, performed less well in some areas than in others. The relationship between scores on the 13 subsets of items on the Arithmetic test and math anxiety was investigated by correlating each of the 13 subscores with the MARS score. Table 15 contains the results of the analyses and indicates that significant negative correlations were obtained for all subscores except "Addition and Subtraction of Whole Numbers" and "Multiplication and Division of Decimals." Math anxiety seems to be negatively correlated not just with overall math performance, but is differentially related to performance on various types of items.

Another way to examine math abilities was to ask individuals to rate their math ability. Table 16 contains participants' responses on a seven point scale from terrible (coded 1) to excellent (coded 7). Results indicated that, as a group, participants rated their math abilities as being slightly

Table 14

Correlations Between
Anxiety Scores and Total Arithmetic
and Algebra Test Scores

Anxiety Scale	Arithmetic	Algebra (N = 32)
MARS	-.53***	-.32*
STABS	-.23*	-.35*
Fear of Evaluation	-.30**	-.10
Facilitating	.53***	.38*
Debilitating	-.36**	-.39*

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

Table 15

Correlations Between Arithmetic
Subscores and Math Anxiety Scores

Subscore	Correlation
Addition and Subtraction of Whole Numbers	.04
Multiplication of Whole Numbers	-.42***
Addition and Subtraction of Decimals	-.44***
Division of Whole Numbers	-.27**
Meaning of Fractions and Rational Numbers	-.39***
Multiplication and Division of Decimals	-.16
Problem Solving	-.34**
Ratios, Rates and Proportions	-.39***
Meaning of Decimals	-.27**
Addition and Subtraction of Rational Numbers	-.50***
Multiplication and Division of Rational Numbers	-.39***
Properties of Numbers	-.37***
Percentages	-.28**

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

better than poor, although 15 participants rated their abilities as "good", two rated their abilities as "very good", and one person rated her/his math abilities as "excellent." Table 16 also contains sub-groups comparisons of participants' self-estimated math ability. Although there was a tendency for support group participants to score lower than non-participants, and for course registrants to score lower than non-registrants, the differences were not statistically significant at $p \leq .05$.

Previous research has suggested that individuals who do poorly in math may do so because of poor spatial abilities. Although the amount of available testing time precluded administering standardized tests of spatial abilities, participants were asked to indicate their perceptions of their verbal, numerical and spatial abilities.[2] Participants described their abilities in two ways. First, participants rank ordered the three approaches to math by assigning "1" to the approach which most closely described their approach, "2" to the approach which is next most descriptive, and "3" to the approach which is least descriptive of their approach to math. Second, participants rated their abilities in each of the three areas on a five point scale from "much below average" (coded 1) to "much above average" (coded 5).

---

[2]The three descriptions were as follows:

Verbal
Thinks of math in terms of words (e.g., one, two, three) and abstractions; likes word problems. (For example: the sums of the squares of the two sides of a right triangle equals the square of the hypotenuse; two plus two equals four; Company A has 40,000, how much does Company B have?)

Numerical
Thinks of mathematics in terms of numbers (1, 2, 3), formulas ($y = f(x)$) and symbols; likes calculating. (For example: $a^2 + b^2 = c^2$; $4 = 7 = 11$; $4x = 40{,}000$, $x = ?$)

Spatial
Visualizes math, thinks of math in terms of distances and spatial and physical relationships between objects -- sort of like a mathematical map or drawing a picture; likes geometry. (For example: , :: + ::· = :::::·)

Table 16

Participants' Self-Estimates of their Mathematical Ability, by Group[a]

	Diagnostic Clinic (N = 71)				Support (N = 15)				Non-Support (N = 56)				Course Registrants (N = 29)				Non-Registrants (N = 42)			
	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD	N	%	$\bar{x}$	SD
			3.32	1.50			3.00	1.46			3.41	1.51			3.21	1.57			3.39	1.47
							t = -.94, p = .35								t = .49, p = .62					
Terrible	12	16.9			3	20.0			9	16.1			5	17.9			7	16.3		
Very Poor	8	11.3			3	20.0			5	8.9			4	14.3			4	9.3		
Poor	18	25.4			3	20.0			14	26.8			8	28.6			10	23.3		
Average	15	21.1			3	20.0			12	21.4			4	14.3			11	25.6		
Good	15	21.1			3	20.0			12	21.4			6	21.4			9	20.9		
Very Good	2	2.8			--	--			2	3.6			--	--			2	4.7		
Excellent	1	1.4			--	--			1	1.8			1	3.6			--	--		

[a]Higher means indicate higher perceived abilities in math.

Table 17 contains a description of participants' typical approach to solving math problems. As the results indicate, participants indicated that they were primarily numerically oriented in their approach to math; 29 participants (40.8%) selected the numerical as their typical approach to math. Approximately the same number of individuals said that they were either verbal or spatial in their approach to solving math problems. These results are difficult to interpret without other data to indicate how individuals not participating in the Math Anxiety Program answered such a question.

Table 18 contains the participants' descriptions of their verbal, numerical and spatial abilities in relationship to doing math. Means for all three were below average, although the mean for spatial ability was the lowest of the three ratings. Previous research has suggested that one factor contributing to poor math performance, especially for women, is related to poor development of an individual's spatial abilities.

Participants' responses concerning their verbal, numberical, and spatial abilities were correlated with Arithmetic and Algebra test scores and the five anxiety scales. Table 19 contains the results of the correlational analyses. Four of the seven correlations with verbal and spatial ratings and six of the correlations with numerical ratings were statistically significant at $p \leq .05$. There was a slight tendency for correlations with spatial ratings to be lower than for either the verbal or numerical ratings.

A similar set of exploratory questions concerning preferences for working with data, people, or things, and participants' perceptions of their

Table 17

Participants' Perceptions of their Approach to Mathematics, by Rank Order

Approach	Ranking[a]					
	Most Descriptive		Second Descriptive		Least Descriptive	
	N	%	N	%	N	%
Verbal	17	23.9	28	39.4	19	26.8
Numerical	29	40.8	5	21.1	20	28.2
Spatial	17	22.5	21	29.6	27	38.0

[a]Seven participants did not complete the rank ordering.

Table 18

Participants' Perceptions of Verbal, Numerical and Spatial Abilities for Doing Mathematics

Abilities	Much Below Average		Below Average		Average		Above Average		Much Above Average		$\bar{x}$	SD
	N	%	N	%	N	%	N	%	N	%		
Verbal	16	22.5	19	26.8	22	31.0	8	11.3	1	1.4	2.38	1.03
Numerical	18	25.4	22	31.0	13	18.3	13	18.3	1	1.4	2.36	1.12
Spatial	21	29.6	22	31.0	17	23.9	5	7.0	1	1.4	2.14	1.01

Table 19

Correlations Between Test Scores
and Perceived Verbal, Numerical, and Spatial Abilities

Scale	Verbal	Numerical	Spatial
Arithmetic	.59***	.50***	.43***
Algebra	.07	.58***	.16
MARS	-.46***	-.44***	-.31**
STABS	-.19	-.22*	-.04
Fear of Evaluation	-.23*	-.28**	-.28**
Facilitating	.28**	.33**	.23*
Debilitating	-.19	-.15	-.16

*p ≤ .05

**p ≤ .01

***p ≤ .001

skills in dealing effectively with data, people, and things.[3] Table 20 contains the participants' rank ordering of their preferences in terms of which they most preferred to deal with and Table 21 participants' perceptions of their skills in each area.

Results contained in Table 20 indicated that although a majority of participants (N = 45 or 63.4%) preferred to deal with people, a sizeable number (N = 24 or 33.8%) preferred to deal with data. The relatively large percentage who preferred to deal with data may be a somewhat surprising finding for participants in a math anxiety program but is congruent with previously reported results concerning participants attitudes toward math.

Participants' ratings of their abilities for dealing effectively with data, people, and things, contained in Table 21, indicated means which were above average for both people and data, but slightly below average for dealing with things. Ratings for these dimensions tended to be considerably higher than the data, contained in Table 18, concerning participants' perceptions concerning their skills in doing math.

These three ratings were then correlated with Arithmetic and Algebra test scores and each of the five anxiety scales. Table 22 contains the results of those analyses. Statistically significant correlations were

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[3]The descriptions were as follows:

Data
: Prefer to deal with information, knowledge, or concepts, involving observations, investigation, interpretation, and other mental processes.

People
: Prefer to deal with human beings, individually or in groups; involving listening, talking and other modes of interpersonal communication.

Things
: Prefer to deal with inanimate objects such as substances, materials, machines, tools and equipment; dealing with tangible objects which have shape, form, and other physical characteristics.

Table 20

Participants' Preferences for Working with Data, People or Things, by Rank Order

Item	Ranking[a]					
	Most Descriptive		Second Descriptive		Least Descriptive	
	N	%	N	%	N	%
Data	24	33.8	31	43.7	14	19.7
People	45	63.4	20	28.2	4	5.6
Things	4	5.6	16	22.5	49	69.0

[a]Two participants did not complete the rank ordering.

Table 21

Participants' Perceptions of Skills
in Effectively Dealing with Data, People and Things

	Much Below Average		Below Average		Average		Above Average		Much Above Average		$\bar{x}$	SD
	N	%	N	%	N	%	N	%	N	%		
Data	4	5.6	9	12.7	25	35.2	26	36.6	1	1.4	3.17	.91
People	3	4.2	2	2.8	20	28.2	89	40.8	12	16.9	3.68	.96
Things	8	11.3	16	22.5	28	39.4	12	16.9	2	2.8	2.76	.99

Table 22

Correlations Between Test Scores
and Perceived Skills in Dealing with Data, People and Things

Scale	Data	People	Things
Arithmetic	.40***	.11	.25*
Algebra	.30*	.20	.11
MARS	-.31**	-.08	-.26*
STABS	-.17	-.11	.01
Fear of Evaluation	-.14	-.26*	-.22*
Facilitating	.36**	.04	.10
Debilitating	-.12	-.12	-.10

obtained between self-ratings and dealing with data and the Arithmetic and Algebra test, the MARS, and Facilitating anxiety. Only one of the seven correlations with self-ratings for dealing with data was significant (Fear of Evaluation), and three of the correlations for dealing with things were statistically significant at $p \leq .05$.

The final ability-related question directly focused on participants' perceptions concerning sex differences in math ability. The specific question was "who is better at math, boys, girls, or are both equal?" Twenty-two participants (31.0%) thought that boys were better and 43 participants (60.6%) thought that boys and girls were equal, but no participants thought that girls were better. Comments from those individuals who thought boys were better were of the following four types: "it's due to the socialization process" (56.5%), "boys have greater innate ability and interest" (21.7%), "it's always been that way" (17.4%), and "boys use it more on a day to day basis" (4.3%). Some illustrative comments are as follows:

> "It is not sex-linked, but encouragement linked. I wasn't encouraged to take math because no one felt a drama teacher would need it -- who would guess I'd end up in the computer industry instead. My male peers were headed toward science careers, so they were encouraged to take math courses."
>
> "Boys seem to have more black and white logical minds -- quicker grasp."
>
> "I feel that problems are often couched in 'male' terminology i.e., baseball fields, football fields, etc. Also I think that because boys look at sports statistics such as RBI's etc. that they become more familiar with numbers in everyday situations."

Comments from those who thought boys and girls were equal fell into four categories: "there's no reason to believe they're different" (46.3%), "ability is equal, but girls are often discouraged" (24.4%), "you learn math, it has nothing to do with innate ability" (24.4%), and other (4.9%). Some illustrative comments from these individuals are as follows:

"I do not think men or women are inherently better than the other sex in any intellectual field. I think men are represented to a greater extent in the scientific fields because society encourages that image of male vs. female roles and abilities."

"After working with students for 23 years -- no difference -- only the brainwashing that girls are not to be good in math."

"Math is a learned ability, like a language. Aptitude has nothing with sex . . ."

"It seemed as a 'getting wet again clinic,' I'm afraid to take math because I hate it. It got me to face this fear and think about my math course."

"The comfortable atmosphere for someone just getting back to school and the complete understanding the instructor had for where each of us was."

4 Evaluative Information

CHAPTER IV

EVALUATIVE INFORMATION FOR FALL SEMESTER PARTICIPANTS

The previous chapter described the results of the tests and questionnaires which were administered during the Diagnostic Clinic. The primary purpose of the previous chapter was to provide an extensive portrayal of the person who is "anxious about math." In contrast, the present chapter presents detailed evaluative information concerning the overall effectiveness of the Math Anxiety Program. Results of the evaluation are outlined for each of the following types of evaluative information: participants' evaluations of courses, particpants' evaluations of the support group, and empirical assessment of effectiveness.

Participants' Evaluations of Diagnostic Clinic

Of the 70 individuals who participated in the Diagnostic Clinic, 51 (72.8%) returned their completed "Diagnostic Clinic Evaluation Questionnaire." This section of the report summarizes their responses to that questionnaire. Although the questionnaire dealt with the effectiveness of the Diagnostic Clinic, it is likely that evaluations of the Diagnostic Clinic may have been influenced by participants' evaluations of other components of the Math Anxiety Program (i.e., courses and the support group).

The first section of the questionnaire dealt with goals of the Math Anxiety Program and the extent to which participants accomplished their various goals. The goal list was developed from previously described questions administered during the Diagnostic Clinic. Table 23 contains a list of the various goals, the number of participants who indicated the goal as one of their specific goals, and the degree to which the goal was accomplished. For example, 34 participants said that "To eliminate fears, get rid

of mental blocks" was a goal for them; average goal attainment was 2.91 (i.e., slightly less than fairly well or 3.00).

Not all who participated in the Diagnostic Clinic enrolled in math classes during fall semester. Course registration lists indicated that 37 participants (52.1%) enrolled in one of the three math classes (Arithmetic/ Elementary Algebra, Intermediate Albegra, and College Algebra). Twenty-six of those individuals completed the Diagnostic Clinic Evaluation Questionnaire. Another 10 individuals indicated that they planned to enroll when they took part in the Diagnostic Clinic but then, for a variety of personal reasons, did not enroll in a math class.

Students who planned to enroll in one of the math classes in the Math Anxiety Program during fall semester but who did not actually enroll listed their reasons as follows:

"I enrolled in Psy 3-801 statistics instead."

"Could not attend any time during the day because of my regular curriculum."

"Course offered at inconvenient time of day."

"Wrong time. None were held in St. Paul; could only attend evenings."

"I enrolled in a correspondence course and I am completing lessons now."

"Too many other classes. Math is not a requirement in my programming sequence."

"These classes were not given in the evening. I work during day, PLEASE begin night classes."

"Enrolled but could not complete due to job conflict. I need an evening class."

"I was too busy completing my Minnesota Certification Requirement in human relations."

"The classes offering more individual help (which is what I need) were at MacPhail during the day."

Table 23

Participants' Descriptions of Goals Accomplished

Goal	Number Expressing This As A Goal	Not at All N	Not at All %	A Little N	A Little %	Fairly Well N	Fairly Well %	Very Well N	Very Well %	Exceptionally Well N	Exceptionally Well %	$\bar{X}$	SD
To eliminate fears, get rid of mental blocks	34	4	11.8	9	26.5	9	26.5	10	29.4	2	5.9	2.91	1.14
To gain self-confidence, self improvement	37	2	5.4	5	13.5	13	35.1	12	32.4	5	13.5	3.35	1.06
To evaluate my math abilities	43	--	--	3	5.9	13	25.5	15	29.4	12	23.5	3.84	.92
To improve existing skills	34	7	28.6	3	8.8	6	17.6	12	35.3	6	17.6	3.21	1.41
To learn basics, understand fundamentals	35	6	17.1	2	5.7	5	14.3	15	42.9	7	20.0	3.43	1.36
To facilitate my getting either undergrad or graduate degree	17	3	17.6	4	23.5	4	23.5	5	29.4	1	5.9	2.82	1.24
To become more comfortable doing practical math (e.g., income tax, sewing)	15	3	12.0	5	20.0	4	16.0	9	36.0	4	16.0	3.24	1.30
To increase my employability	16	1	6.3	3	18.8	7	43.8	3	18.8	2	12.5	3.13	1.09

Slightly more than half of the participants in the Diagnostic Clinic indicated, at the end of the Diagnostic Clinic held in September, some interest in participating in the support group; 15 of these participants actually attended one or more of the meetings of the support group. Those other participants in the Diagnostic Clinic who indicated an interest in the support group but who did not attend any sessions, listed their reasons for not participating. The three primary reasons for not participating were that time/location was inconvenient, their schedules were too busy, and that they did not feel that they were anxious about math. Their specific comments were as follows:

"I was not available to attend at the particular times designated for support group."

"I felt I did not need the support group, I only wanted to know at what math level I fit into."

"Did not feel a need for it."

"Because I did not attend regular class. Also, I do not have any anxiety about my ability to learn -- all I need is the opportunity."

"No time."

"No time."

"Not held when my schedule permitted."

"Could not attend class or support group because they were offered at times unacceptable to me."

"Lack of time."

"Forgot and time was not convenient."

"Work conflicted."

"I did not feel that I had many fears or anxieties about math. My main reason for attending the clinic was to evaluate my abilities so that I would know which course to register for. Also, I had a time conflict as I work all day."

"Unable to find the time but also felt there was not a need as I received adequate support from the instructor."

"Time and location."

"I did not feel a need for the support group. I was comprehending the material and gaining confidence in acquiring new skills."

"Because of feeling extremely inadequate in math field; I tend to avoid any serious interests."

"Group met during the day."

"Did not enroll in math course."

"I enrolled in statistics winter quarter. It was a matter of learning extremely new with practically no math background. My problem was ignorance in the subject rather than anxiety. I had a desire to learn. I did not need statistics as a requirement at this point in time."

"Cost for child care made participation expensive for me."

"I went to work in the fall after the diagnostic clinic and therefore did not have time for the class or support group."

"I did not take a course in the fall because of the obligations. I went to the diagnostic clinic to find my place in math if I ever decide to continue."

"Could not fit it into my schedule."

"I felt I did not need it, but would have asked to participate later if I needed it."

"Time for one economics class on St. Paul campus and support group did not coincide. If I had not planned on economics class I would have joined the support group meetings."

"A class and clinic in two different days is too much traveling into the city per week."

"My personal schedule is overcrowded."

"Unable to attend because of part-time employment plus I didn't feel a need for it."

"Inconvenient."

"Lack of need, distance, found support within class."

"Never felt the need for it. I tested just to determine course placement after having been away from math for so long."

"The program was offered during the hours in which I work."

Participants commented about the appropriateness or inappropriateness of various aspects of the Diagnostic Clinic. Their responses are summarized in Table 24. For example, 40 participants (78.4%) said that the overall length of the Diagnostic Clinic was appropriate. Table 24 also contains the comments of those individuals who said that a particular aspects was appropriate. Approximately three-fourths of the respondents responded favorably to the various aspects of the Diagnostic Clinic.

Two other items dealt with participants' overall evaluation of the three-hour Diagnostic Clinic. For the general items, it is likely that respondents' evaluations of other components of the Math Anxiety Program may have influenced their responses to these general items. The first such question was "How would you rate the overall effectiveness of the Diagnostic Clinic?" Responses were as follows: "extremely ineffective" (N = 1, or 2.0%), "very ineffective" (N = 6, or 11.8%), "somewhat ineffective" (N = 2, or 3.9%), "somewhat effective" (N = 10, or 19.1%), "very effective" (N = 15, or 29.4%), "extremely effective" (N = 4, or 7.8%); the average response was 4.57 (SD = 1.52). The second question asked participants to indicate "How much would you say you learned as a result of the Diagnostic Clinic?" On a seven point scale from "very little" (coded 1) to "a tremendous amount" (coded 7), the average response was 4.14 (SD = 1.30), which was slightly higher than "much" (coded 4).

Correlations were obtained between responses to these two general items and participants' responses concerning the degree to which their goals had been met. Results indicated statistically significant correlations for one of the eight goals: to evaluate my math abilities. Correlations were .33 ($p \leq .01$) and .46 ($p \leq .001$), respectively, for the two general items. The degree to which individuals felt that the Diagnostic Clinic helped them to evaluate their math skills was positively related to overall evaluation of the Diagnostic Clinic.

Table 24

Participants' Evaluations of
Appropriateness of Diagnostic Clinic Activities

Aspect	Appropriate N	Appropriate %	Inappropriate N	Inappropriate %	Comments from Participants who Indicated Inappropriate
Overall length of Diagnostic Clinic	40	78.4	3	5.9	"Exhausting."
					"Could have been briefer by elimination of Math Anxiety Rating Scale."
					"I feel I would have benefited just from the Math placement test not all the other testing."
Amount of time devoted to administrative details	40	78.4	3	5.9	"Too much time spent."
					"Give test, Math, nothing else."
					"I feel I would have benefited from the Math placement test not all the others."
Amount of time devoted to tests and questionnaires	37	72.5	6	11.8	"I wish the DEGREE of anxiety not math ability was sent to me."
					"The questions did not seem varied enough from each other -- became too long."
					"Too much time spent on psychological, math anxiety part."
					"I was last to finish the arithmetic part of the the tests and this seemed to make tester (the male one) anxious. I was doing fine, but he seemed antsy. I did well enough to take the algebra diagnostic test. He needs to know that his anxiety is distracting."

Table continued

Table 24

Participants' Evaluations (continued)

Aspect	Appropriate N	Appropriate %	Inappropriate N	Inappropriate %	Comments from Participants who Indicated Inappropriate
					"Exhausting, too much time spent before actual problem solving."
					"I feel I would have benefited just from the math placement test not all the others."
Time for introduction, presentations and explanations	40	78.4	3	5.9	"Somewhat drawn out."
Overall organization of the Diagnostic Clinic	38	74.5	5	9.8	"Seemed somewhat disorganized but helpful."
					"Seemed disorganized at the end."
					"Too much time spent on psychological, math anxiety part. Would like to have more discussion on progression of math courses in program, and relationships of math courses to degree programs."
Usefulness of results sent to me	40	78.4	5	9.8	"I took the evaluation to lose my fears nothing was offered at this end."
					"Would have preferred more personalized detail."
					"Didn't really point out any weak areas or ways I could improve on them."
					"Being placed in the proper math section was helpful."
					"I never received results!"
					"I knew how much I needed to learn -- the score did not surprise me."
The $5 participation fee	43	84.3	--	--	

An open-ended question ["With what aspect(s) of the Diagnostic Clinic are you satisfied?"] to determine their overall positive feelings about the Diagnostic Clinic. Thirty-eight participants responded to this question; their specific responses were as follows:

"It got me focused in the correct direction, gave me a class to start working on."

"Correct evaluation/attitude of staff -- knowing we would succeed and have help if we took the course."

"The fact that they kept stressing that anyone could learn math."

"It served my purpose."

"I learned how much of my high school math training I retained and how much I needed to review before going on. I found out what level course I should take."

"Testing was excellent. It showed my strengths and weaknesses."

"The test. I got a perfect score; I really felt good about that."

"All."

"Results of the tests."

"The testing and test results returned -- then the follow up classes."

"My results improved my attitude toward my ability in math."

"It substantiated the fact that I have math anxiety and pointed to my weakest areas."

"It was thorough and helped me face up to my inability."

"All aspects."

"I scored on the math test just about as low as I thought I would. I was excited to see how I improved but we were never given the test over."

"I discovered what parts of math I needed improvement in."

"The enthusiasm of the organizers and speakers and their patience and willingness to help; also, the fact that it was organized, well-paced, not boring, not alot of writing."

"Whole thing."

"Test. Information about anxiety that in fact exists in many areas."

"I am pleased that it does exist. There are many others also suffering from math anxiety and willing to check it was encouraging."

"With evaluation of math skills and general picture given of program."

"Follow up letter and analysis."

"It confirmed my low math ability."

"I had no opinion at all really. The three hours were a chore because I had not done anything like that for so long but that was not a fault of the clinic."

"All aspects."

"The results of my test showed me to be exactly where I felt I belonged."

"I am aware of the level of my skills and have a better idea of what course I would best start at."

"I benefitted from the self evaluation it gave me and subsequently spurred me on to try a statistics course."

"It seemed as a 'getting wet again clinic,' I'm afraid to take math because I hate it. It got me to face this fear and think about my math course."

"Nearly all. It was an excellent effort; I learned what I wanted to know, felt good about it. Felt people testing were basically really interested in what we were all doing."

"Reinforcement of what I thought my level was. Appreciated follow-up letter and advice from instructors."

"Math skills evaluation."

"Test showed my weaknesses."

"Testing, goals of the clinic, the idea of the clinic itself. Time held was also acceptable at the time of year."

"Showed where I was at in Math. Didn't have as many hang-ups about math as I thought I did."

"Detailed results sent on proficiency and comparative performance in each area."

"The math placement test."

Participants also responded to the question "With what aspect(s) of the Diagnostic Clinic are you dissatisfied?" which was included to obtain an indication concerning ways in which the Diagnostic Clinic could be improved. Eighteen

participants noted aspects with which they were dissatisfied. Their specific comments were as follows:

"No results. Other than placement in math class appropriate to my skills (accurately) on the day of the testing I have received NO results on which to base an effectiveness evaluation. I have no idea of the degree of anxiety I may have shown."

"Again I feel it was unnecessary to test anything except skills."

"Uncomfortable room, rather crowded, it was also somewhat disorganized, drawn out presentations, impersonal format. Location at MacPhail Center is poor."

"I took the course because of math fear that makes it impossible to learn elementary principles. I knew my ability. I just wanted to stop fearing math. It seems the anxiety test didn't even matter because I only received results on my math ability."

"Support group leader did not have equal opportunity to explain what she is going to do."

"Too much time spent on the psychological, math anxiety part."

"I knew that I wanted to start at the beginning and work up. I wanted to eliminate any reason for failure on my part to reach my goals."

"The time stated for the testing seemed short and there was considerable leeway allowed. A more realistic picture is better I think."

"The fact that the program is not offered through Extension. It's hard to take morning off work."

"Would have liked to have advanced test given at clinic instead of taking it home to do."

"None except I have never received any information as to how I did on the Anxiety test."

"Did not present any suggestions for source material dealing with math anxiety. I would really like to read some research about the subject."

"Location of test and class."

"Too much emphasis on anxiety. I don't have deep unconscious mental blocks about math. I just didn't take enough in high school because I mistakenly thought it was unimportant for girls."

"To attend the three hour sessions and then find out I could not proceed because you do not have night classes."

"I think there was too much to do in too little time, especially since we were all blocked to math to begin with. The short time period may have caused some needless anxiety."

The last open ended question asked participants for suggestions concerning changes in the content and/or format of the Diagnostic Clinic. Their specific comments were as follows:

"Short ditto, give test, after test. Tell what has been measured. Spend less time, various parts explained. This test will measure this."

"Suggestion for classes. I would have learned, absorbed more confidence if the course I took at St. Louis Park had covered less ground and covered it more thoroughly. Anyone (me) who has need of remedial math needs more than one and one half sessions on any new area in math. I worked hard (even went to grade school section of the library for math books to practice) tenously understood the math, but more homework and more time on review and less new math to comprehend so quickly, I think would have gained more confidence. The teacher was kind, patient and good. I am saying only that remedial math should be kept more SIMPLE."

"Skip the anxiety testing and concentrate on placement."

"More emphasis on math in computers, statistics, etc. Beyond the basic level."

"Better site, smaller clinics being held (as opposed to one large one) improved organization, more casual atmosphere, more personalized format, perhaps a Saturday morning time."

"None."

"Would like to have more discussion on progression of math courses in University Program and relationship of math courses to degree program, i.e., why calculus is required in business school."

"Perhaps something on how to follow up math courses in other courses in CEW in other words, where can I count on going from here without going to campus?"

"Possibly some subsequent individual counseling of the participants."

"Offer it through extension; you are missing alot of people (working women)."

"After completing the math course every Monday 9:30 - 12:00, we <u>definitely</u> should have been given the same test as we took during the Diagnostic Clinic. You work hard for a whole semester and you need to know how much you have learned by comparing the same test."

"A time limit on the test."

"On site, immediate individual placement."

"Lengthen the time by, oh say, a half hour. Keep same format and content."

"Possibly lengthen the entire clinic to give time for coffee break, plan a coffee time immediately after the clinic to give people a chance to chat, compare impressions, unwind, come down, whatever. Plan this as a part of the clinic and let people know it will occur."

Students' Evaluations of Courses

Three math courses (Arithmetic and Elementary Algebra, GC 1445: Intermediate Algebra, and Math 1111: College Algebra and Analytic Geometry) were offered during fall semester as part of the Math Anxiety Program. Enrollment in the courses was not limited, however, to individuals who had participated in the Diagnostic Clinic. A copy of the "Course Evaluation Questionnaire" was sent to all individuals who had been registered for any of the three courses noted above. Completed questionnaires were obtained from 22 of the 35 students who had registered in Arithmetic and Elementary Algebra (25 of whom participated in the Diagnostic Clinic), six of the 12 students in GC 1445 (eight of whom particpated in the Diagnostic Clinic), and six of the six students in Math 1111 (four of whom participated in the Diagnostic Clinic). The present section describes results of the course evaluation for all students, regardless of whether or not they attended the Diagnostic Clinic. The majority of returned questionnaires were obtained from individuals who participated in the Diagnostic Clinic.

Not all individuals who registered for a course actually completed it. With few exceptions, however, their reasons for not completing the course were personal. Specific comments of students who dropped each of the courses were as follows:

Arithmetic and Elementary Algebra

"Erratic attendance on my part."

"I have not taken the final test as yet but intend to do so shortly. Because of a great deal of illness in family, I fell behind."

"My goal was to finish the book -- I didn't finish the last part. Had some difficulty working on the last part on my own -- had I had more instruction (class) it might have helped!"

"Got too busy at home to spend the time on homework -- however, since the course was open ended and up to me, I'm not sure what constitutes completed."

"I am not taking the course this semester because of illness in the family and other conflicts this spring."

"Husband became ill and was hospitalized."

GC 1445

"Job conflict. I would love an early evening or late afternoon class."

"Lost interest, but felt book was frustrating in it's approach, to important knowledge almost to the point of being childish."

Math 1111

"I changed hours over Christmas and I had to take a quarter course in Statistics beginning January 4 which conflicted. The instructor offered special help to finish algebra so I could take the exam but the timing -- Christmas -- was not appealing."

"I dropped the course after the midpoint because my goals changed. We had already covered the areas I was most interested in. I decided I did not want to increase the time required to finish the course.

Students in each of the classes described their objectives in taking the class and indicated how well the class had met that objective. Students in Arithmetic and Elementary Algebra listed their objectives as follows:

"To review math -- felt inadequate."

"Improving my math skills, I felt, is one of the objectives of my well being."

"To brush up on what I had forgotten or never had so I could continue on and take Algebra and then Statistics."

"To regain basic skills and confidence -- to develop a positive attitude towards math and my ability to do it."

"To become more knowledgeable and comfortable with large numbers. Also, for personal, e.g., checkbook, bill payments use."

"To fill a void -- unbelievably inefficient math background -- to see if I could grasp it after so many years of avoidance."

"To learn to figure better."

"A positive use of my time and interest in finding out what math I knew already and learning more."

"Up grading my algebra abilities to college level."

"I have had only one year of high school math (Algebra). I want to review that, learn the current math 'language' and advance to where I can take a college algebra course."

"To prepare for graduate record exam-review."

"I wanted to improve and build skills in working with mathematical questions."

"I need to take two college level math classes to get into Business Administration."

"To lose math anxiety and eventually I hope to understand finances and the stock market in particular."

"To become familiar with a classroom situation and to try to study again in an unpressured situation."

"To review and improve my abilities (in order to take and successfully complete GC 1445, then go on into Home Economics Department)."

"To improve my overall math ability in public situations."

"Background knowledge in Algebra."

"My single objective was to find out if I was as stupid about math as I had been led to believe."

"A better understanding and loss of anxiety."

"To review Algebra and learn more modern methods of problem solving."

"Learn basic math, overcome math avoidance, see if I could apply myself to study after 20 years, see family reaction to my going to school."

Students in Arithmetic and Elementary Algebra indicated how well their objectives were met on a five point scale from "not at all" (coded 1) to "extremely well" (coded 5); the average response was 4.08 (SD = .92). Frequencies and percentages in each category were: "slightly well" (N = 2, or 9.1%), "somewhat well"

(N = 2), or "very well" (N = 10, or 45.5%), and "extremely well" (N = 7, or 31.8%).

Similar data were obtained from students in GC 1445. Their statements of course objectives were as follows:

"To gain background preparation for taking Math 1111."

"Entrance requirement for degree program if I go on."

"Learning some math that I wanted to know, and proving to myself that I could learn it! Also, thought it would help me in further study at graduate level."

"Brush up on my algebra to prepare myself for Math 1111."

"Math knowledge."

The average response concerning how well their objectives were met was 3.60 on the same five-point scale described above; three students responded "very well," and one each responded "slightly well," "somewhat well," and "extremely well".

Students in Math 1111 responded to the same two questions as students in the other two courses. Their objectives for taking Math 1111 were as follows:

"To possibly qualify for Business School."

"Thought I wanted calculus but I do not need it. Good for Statistics 5021 which I am taking now."

"Required for the accounting courses."

"Possibility at that time of continuing my math; good for logical thinking; good for gaining confidence."

"For degree requirement."

"Upgrade skills. Gain knowledge and self-confidence."

The average responses concerning how well the course had met these varied objectives was 4.67 (SD = 52). Two students responded "very well" and four students "extremely well".

Students responded, on a seven point scale from "very strongly disagree" (coded 1) to "most strongly agree" (coded 7), to a series of 16 specific items concerning various aspects of each of the courses. Table 25 contains the average

Table 25
Students' Responses to Specific Course Evaluation Items

Item	Arithmetic $\bar{x}$	Arithmetic SD	GC 1445 $\bar{x}$	GC 1445 SD	Math 1111 $\bar{x}$	Math 1111 SD
1. The instructors had a sufficient grasp of the subject for my needs.	6.10	1.09	6.33	1.21	7.00	--
2. The instructors presented the course content in a clear manner.	5.95	1.15	5.50	2.51	7.00	--
3. The instructors covered the course materials at an appropriate level of difficulty.	5.57	1.33	6.40	1.34	7.00	--
4. The instructors welcomed questions from students.	6.46	1.10	6.67	.82	7.00	--
5. The instructors were available for individual help.	6.57	.98	6.83	.41	7.00	--
6. The instructors were willing to discuss test results with students.	6.27	1.20	6.80	.45	7.00	--
7. The instructors made this course as stimulating as the subject matter permits.	5.73	1.32	5.50	2.51	6.67	.52
8. The instructors built up confidence in students.	6.04	1.29	6.17	1.60	6.50	.84
9. The text is relevant to course objectives.	6.14	1.08	4.83	1.72	5.33	1.63
10. The text is of the right difficulty for this course.	5.82	1.14	5.00	1.67	5.50	1.38
11. The other students in the class contributed to my learning.	3.36	1.62	3.50	1.23	5.33	1.37
12. I have achieved a good grasp of the course content.	4.91	1.14	5.00	1.41	5.00	.63
13. I have become more open to math.	5.23	1.31	5.00	1.67	4.83	.75
14. I can work arithmetic problems more effectively as a result of this course.	5.24	1.14	5.00	1.67	4.67	2.07
15. I can work algebra problems more effectively as a result of this course.	5.05	1.67	5.20	1.64	6.00	.89
16. This course has been helpful in preparing me for possible future jobs.	4.50	1.32	4.20	1.79	4.33	.52

responses for students in each of the courses. For example, the average response for students in Arithmetic and Elementary Algebra to the question "I have become more open to math" was 5.23. Table 25 may be summarized as follows: 1) for all three courses for most of the 16 items (with the exception of 11 and 16), response means indicated very favorable evaluations of the courses (i.e., students ranged from moderately agree to most strongly agree for most of the items); 2) although there were some differences in level of positive evaluation of the three courses, these differences tended to be small but consistently indicated the highest possible evaluation for Math 1111; and 3) none of the responses to these 16 questions indicated aspects of the courses which were unsatisfactory.

Students also responded to two general items concerning overall effectiveness of the course and self-estimate concerning how much they learned in the course. Table 26 contains a description of those results for each of the three courses. Results contained in this table confirm the results concerning students' evaluations of specific aspects of the course.

Students were asked to comment about the strengths and weaknesses of the courses. Students in Arithmetic and Elementary Algebra commented upon the strengths of the course as follows:

> "There was no pressure. You work at your level and your convenience. It is challenging to work at a faster pace if you are able, if you are not able, there is no feeling of rejection."
>
> "Warm, understanding teacher."
>
> "The non-threatening approach. The individual programmed text which helped me feel as though I was teaching myself."
>
> "The text, teacher knowledge and support, opportunity to DO math. Consequently, progress in skills and confidence."
>
> "Students were there on time. The teacher gave out the tests when we wanted them."
>
> "Just the availability of an opportunity to evaluate my progress and the guidance."

Table 26

Students' Responses to General Course Evaluation Items

Item / Course	Response Categories												$\bar{x}$	SD
How would you rate the overall effectiveness of the course?	Extremely Ineffective		Very Ineffective		Somewhat Ineffective		Somewhat Effective		Very Effective		Extremely Effective		Superbly Effective			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Ar. & El. Alg.	--	--	--	--	--	--	3	13.6	7	31.8	10	45.5	2	9.1	5.50	.86
GC 1445	--	--	--	--	1	16.7	1	16.7	1	16.7	2	33.3	1	16.7	5.17	1.47
Math 1111	--	--	--	--	--	--	--	--	2	33.3	3	50.0	1	16.7	5.83	.75
How much have you learned as a result of this course?	Very Little		Little		Some		Much		Very Much		Very Very Much		A Tremendous Amount			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Ar. & El. Alg.	--	--	--	--	2	9.1	4	18.2	5	22.7	8	36.4	3	13.6	5.27	1.20
GC 1445	1	16.7	--	--	--	--	1	16.7	2	33.3	1	16.7	1	16.7	4.67	2.07
Math 1111	--	--	--	--	--	--	--	--	2	33.3	3	50.0	1	16.7	5.83	.75

"Very helpful and qualified instructor. Initiates and discusses your problem areas with you to work them out."

"Excellent text and teacher who is knowledgeable and approachable. Opportunity to start at one's own level of knowledge. I did not use the support group or tutors but I would think this would be invaluable to those in need."

"The teacher was prompt, patient, went over materials until all understood before advancing to new subjects."

"The acceptance, patience, and exactness of the instructor."

"The thoroughness in which the book covers the subject matter. I really enjoyed studying from this book."

"The comfortable atmosphere for someone just getting back to school and the complete understanding the instructor had for where each of us was."

"Being able to stick with/to something until I understood it, then do many examples of the same type to plant the roots of learning it."

"I was solely responsible for my success. I had very little contact with the instructor -- I was pleased with my own performance."

"To build math confidence in the students."

"Individual help."

"To work at an individual level is reassuring. The patience and encouragement of the instructor were so helpful. She is willing to explain and to re-examine until you understand and then she rejoices with you. It is great to not be scolded because you do not catch on at first."

"Simplification. No pressures."

"The programmed learning from book made it easier for me to work problems at my own speed."

"Moral support of teacher and other students. Solid basic arithmetic with step by step building of skills."

Students in Arithmetic and Elementary Algebra also commented upon the major weaknesses of the course. On analysis the 16 responses indicated that the primary weaknesses related to characteristics of students rather than weaknesses of the class per se. Their specifc comments were as follows:

"I did not take enough time myself outside of class to work on as many problems as I should have to advance to the level I had wanted to during the course."

"Three hour class in Math (figures) is too long."

"None, the only weakness was my lack of time. I guess the ideas soak in slowly."

"The student must be self-motivated."

"Students left too much on their own; 'going at own speed' does not force the busy student to spend time on the course. Still I think assignments to be turned in each class are a better incentive. I would guess that all those students who dropped away were just plain discouraged from working on their own. You must remember the average student in this type of class is a product of a structured teaching system and does not understand or know how to work independently."

"The instructor did not have a copy of the text I was using; she was not aware of it's content which proved to be disconcerting and confusing."

"All the typographical errors in the book."

"None; teacher was good, material well-organized and geared to students' abilities."

"One of the strengths was also a weakness. Since we could proceed at our own pace, I did not push. I realize this indicates a lack of self-discipline and is not the fault of the program. However, it would have been helpful to me know know how much work must be accomplished each week to prepare for the next level class. Also, I really do not know what the classes mean; for example, when I have completed my text will I have the equivalent of one year high school algebra? Two years? Am I ready for a CLA Algebra class? How much math do I need in the CEW program to meet the requirement for Home Economics? One other minor point, lack of a formal class program did not allow for interaction between students. I do not know the names of any students in my class."

"None, except possibility of cancellation because of limited enrollment. Everyone wants to continue through all levels of algebra."

"Perhaps a 'contract' for people like me -- something to aim at when on a non-credit basis. I put in a lot of time in the first weeks knowing I would be able to de very little work after the end of November. I feel I covered quite a bit in the time I spent but it might have been helpful to have set goals in consultation with an instructor. (I'm sure if I asked the instructor she would have done this -- she was always most willing to do whatever she could.) I might also add here that changing instructors probably did not work out to my advantage either. Perhaps if I had not moved into another class I would have 'found the time' to attend class and at least spend these hours on math

(I felt if I didn't have time to do homework there was not much point in coming to class)."

"Both were equally willing to help, but I just hadn't been in that class long enough to miss it if I didn't go."

"Some didn't do the lessons as fast as others."

"Having the male professor in the same room while speaking constantly to his pupils. It was distracting."

"None, everything you need is available for the asking at any time."

"My lack of attendance -- no deadlines or goals set!"

Students in GC 1445 commented upon the strengths of their course as follows:

"The instructor's individual help, his not pushing to move us at too fast a pace, and his attitude when we asked questions (never made one feel the question was stupid)."

"The openness and availability of the instructor to questions. No question was ever to small . . . created confidence in me as to my possibilities."

"The instructor."

"Excellent teaching and help available when necessary."

"Excellent instructor and small class."

"The only advantage was that one could work at one's own speed."

Their comments concerning major weaknesses of the course were as follows:

"There was hardly any lecturing. We worked alone. The book and instructor were available for explanations and corrections. This is hardly a way to gain confidence if that is the prime objective of the course."

"The time of day . . . I need an evening class."

"Infrequency of meetings. Once a week is a long time between classes for a subject like math."

"Me!"

"Expectations of homework or how to best get out of the class what was needed were unclear. It was unclear as to what subject matter we were covering and when."

"Because we needed so much time to grasp subject, I felt it could have been spread over a longer period of time."

Finally, students in Math 1111 commented about the strengths and weaknesses of their course. Their comments about the strengths of the course were as follows:

"Our capable and helpful instructor."

"Clear teacher and small class, we all got along well."

"Small class size and approachability of instructor."

"The instructor and the size of the class made almost private tutoring. The instructor was great at explaining."

"The small class and the good instructor."

"The instructor."

Their comments about weaknesses of the course were as follows:

"Perhaps the break over Christmas for backskiding."

"Christmas break was a bad disruption. Can't think of others."

"Would have preferred tables to folding chair desks!"

"Book was a little spare, but it's the one other classes use. Maybe one and one-half hours three times a week would have been better."

"The text introduces a concept but, just gives a few problems to work out. Did not provide enough examples of how to work problems. The written material was not clear, concise or particularly informative. I view the text as a barrier rather than as an aid to learning."

Taking a course during fall semester was an important step in helping the students increase their math skills and become less anxious about math. Students in each class indicated what "next steps" they planned to take.

Arithmetic and Elementary Algebra

"Using math more and more on a day to day basis."

"Not sure, will probably take additional Algebra in the future for own personal growth."

"I enrolled for the next course, even though I shall be out of town for three weeks. I know I'll still learn some exciting things. Math exciting -- imagine!"

"Intermediate Algebra."

"I still need to sharpen my skills in public situations -- probably should have taken the extra day for the support group."

"I am enrolled in the second semester introduction to Algebra class. I plan to continue this program through GC 1445 and whatever is necessary to go into Home Economics."

"I will take GC 1445 in the Fall."

"I didn't have any particular anxiety. I am taking the class second semester and plan to take accounting next year."

"I am presently enrolled in CEW Intermediate Math. I am planning on enrolling the College Algebra in the Fall and Calculus in the Winter of '78."

"I want to continue in the Algebra course but was unable to this spring because of previous commitments. I have already found I am more willing to and able to tackle home finances and do my own calculations for volunteer activities."

"I am now taking a course in Business Machines using adding machines and calculators -- I can be more confident in their use because of my math course."

"I plan to continue on the text at home this winter. Hopefully I will be ready for an advanced class in the fall."

"Continuing with the Algebra courses."

"I will work at home with the books. I have no plans at this time for formal classes."

"I will take more classes in Algebra and in accounting."

"Continue to work with: checkbook, mortgage, insurance income and property taxes, investmenst and stocks, interests, etc., money management, annual reports, and volunteer hours, mileage and expenses."

"I am presently enrolled in Intermediate Algebra."

"I have been discouraged by another professor to continue and apply for my masters. As a result, I have decided to disconue my desire for further education."

"I plan to continue on with this class and hopefully make progress. Next semester I would like to take the next step by taking the class Intermediate Algebra."

"To continue with the next class."

GC 1445

"First, I was never anxious about math. If I were to take another math course it would be under more mature tutelege. Instructor treated us

(mostly women except for one) or rather talked to us as if we were elementary school students. He meant well, but it could hardly be called a pre-college level."

"No definite plans at this time."

"I really think that I need more exposure to Algebra before I take Math 1111."

"I would love to become completely confident in my math skills so I could take any math course without apprehension."

"I am participating in Math 1111 through Extension."

"Will enroll in Math 1111 in the future."

Math 1111

"None, at this time. Graduation complete."

"Taking Statistics now. Entering General College in spring. Stopping math as I don't want 5-day week classes. Feel that this is all the math that is practical for my broad program."

"Taking Math 1142 Spring Semester '77."

"Taking Statistics 5021 on St. Paul campus. Probably take 5022."

"When possible I would like to take the first Calculus course."

Participants' Evaluations of Support Group

Fifteen individuals participated in one or more of the sessions of the support group. Each of those individuals received a copy of the "Support Group Evaluation Questionnaire". The present section of this report summarizes the responses of the 11 individuals who returned their questionnaires.

Attendance at the support group was not as regular as might have been hoped. Participants indicated how many of the sessions they attended as follows: one (N = 1, or 9.1%), three (N = 2, or 18.2%), four (N = 3, or 27.3%), five (N = 3), and six (N = 2). These respondents were consistent with the leader's impressions concerning attendance. Those individuals who began the support group but who did not attend a majority of the sessions indicated their reasons for dropping out as follows:

"Could have done some amount of discussion in one hour, especially as size of class dwindled each time."

"Long enough to convey ideas, thoughts, and emotional feelings and get support and reassurance."

The support group included a number of different activities dealing with math anxiety. Table 27 contains participants' evaluations of each activity in terms of whether or not they felt the activity was beneficial and then commented about the strengths/weaknesses of the activity. For example, seven of the participants felt that the general discussion of math anxiety was beneficial.

Two questions dealt with overall evaluations (i.e., effectiveness and self-estimated learning) of the support group. On a seven point scale (1 = extremely ineffective to 7 = extremely effective), the average rating concerning overall effectiveness of the support group was 4.13 (SD = .64) which was between "somewhat effective" (coded 4) and "very effective (coded 5). On a similar seven-point scale concerning learning which occurred in the support group (1 = "very little" to 7 = "tremendous amount"), the average rating was 3.50 (SD = 1.31) which was midway between "some" and "much".

Participants commented about satisfying and dissatisfying aspects of the support group. Specific comments concerning satisfying aspects of the support group were as follows:

"If people have math anxiety they need a support group to help them out and I heard good comments about the reassurances they gained from the group."

"Good to meet new people -- hear how they deal with problems."

"Overall interesting. Wondering if I did, in fact, have a hang-up about math. Was able to go ahead and feel good about the class and what was being accomplished."

"It was good to relate to others about the problems. Does not seem to have an age or generation gap."

"I liked knowing clearly what was happening to others. I like getting a better picture of what I did or did not need to do to solve my problem with math."

"Role playing, personal sharing, re: math anxiety, relaxation exercises, lecture, and discussion on assertiveness, math games."

"The leader was on time. She was prepared at each meeting."

"Family and home commitments left too little time to spend on the math program."

"I missed the sixth session due to another appointment — found changes of time and dates confusing."

"I did not feel that I had any particular anxiety. I went into the whole math class to see if I had any aptitude there, if not I would enroll in something else."

"I decided I did not suffer from math anxiety after attending 3 or 4 sessions and listening to the other women and to the leader."

"It consumed too much time and required extra trip downtown. As I got into the course my anxiety was relieved more by successful competition of my work than by going to the support group."

"I thought you had to participate as part of the whole program. Did not have math anxiety so dropped the support group."

Individuals commented about the appropriateness of the number of sessions as follows: "too few" (N = 1, or 9.1%), "just right" (N = 3, or 27.3%), "too many" (N = 2, or 18.2%), and "no opinion" (N = 5, or 45.5%). Specific comments concerning the number of sessions were as follows:

"Perhaps more and more closely spaced meetings would have helped continuity of group."

"Not too many sessions; I think it might be alright if held following class -- after break for lunch."

"For me, too many, but not for the program's objective. I got too busy with family matters."

"I feel my 'anxiety' occurs when directly confronting math and talking about it from a distance does not really help the problem."

A related question concerned the length of each session. Their reponses suggested that the 1 1/2 hours for the support group was appropriate, only one individual thought the session was too long. Their specific comments concerning length of sessions were as follows:

"I much preferred having the support group meet on the same day as the class."

"Goals were usually set and met."

"Very interesting."

Table 27

Participants' Evaluations of Support Group Activities

	Did Not Participate N	%	Beneficial N	%	Not Beneficial N	%	Strengths/Weaknesses
Personal sharing of math attitudes and experiences	2	18.2	7	63.6	2	18.2	"Some people had terrible experiences and was helpful to understand how people were intimidated by instructors in childhood." "Good to hear others had similar experiences." "I enjoyed hearing the attitudes very much." "It helped to see problem not unique and involved many very diverse situations and individuals." "Interesting, but not beneficial." "Helps one to see that one is not alone in this concern; also shows the many forms and causes of it." "Helped to know you were not alone with the feelings." "It is not easy for me to jump in with personal problems, comments, etc."
Discussion of math anxiety	4	36.4	7	63.6	--	--	"Felt the aggressive person using all the time. Perhaps, each given a specific time, ten minutes, to state their reasons." "Don't remember much about this exercise." "More interesting." "However, certain persons monopolized the time." "Helped people to identify their problems and source of anxiety and reactions. Some were terrible."
Focus on unproductive mesages about math ability	3	27.3	8	72.7	--	--	"Still was interesting to me." "Very good, often we do not realize that we are helping put ourselves down and scare ourselves with our own messages." "Identified more clearly what needed to be changed in my attitudes toward myself and task."

-- Table continued --

Table 27 — continued

	Did Not Participate N	%	Beneficial N	%	Not Beneficial N	%	Strengths/Weaknesses
Fantasy about math classes/setting a goal	3	27.3	7	63.6	--	--	"Put emphasis on task at hand." "Made me focus better on what I needed to do about my math."
Relaxation training	5	45.5	3	27.3	3	27.3	"Excellent; would like to have done more of this -- really practiced it in the group several times to get good at it." "More time could be spent on this." "Enjoyed it."
Other methods of relaxation/use in test anxiety	6	54.6	3	27.3	2	18.2	"Test anxiety is not the biggest problem I have with math so I do not really have any comment." "Really beneficial." "Do not have much problem with taking tests."
Assertiveness lecture	6	54.6	4	36.4	1	9.1	"Loved it." "Very good; often we do not realize that we are helping put ourselves down and scare ourselves with our own messages." "Much more time needed here for group, majority not assertive enough. But a few who were naturally, take instructors and class time, etc., to explain their own problems." "In a general way it was good."
Role playing	5	45.5	5	45.5	1	9.1	"More emphasis on this." "Important! So hard to say 'no' and we all need practice and experience. This was a good, non-threatening situation." "Mind expanding."

-- Table continued --

Table 27 -- continued

	Did Not Participate N	%	Beneficial N	%	Not Beneficial N	%	Strengths/Weaknesses
Math games	4	36.4	5	45.5	2	18.2	"Fun." "Enjoyed very much." "Very stimulating." "Fun! Instructive in that we were doing math and having fun. Challenging." "Gave some insights into ways one uses math. I have not been using it and when I can do assignments I still lack the insight to use skills in problem solving." "Used material I had not studied; uncomfortable feelings."
General discussion about classes and texts	5	45.5	5	45.5	1	9.1	"Specifies better use of time." "Helpful to get people to see steps they (and I) must take to accomplish goals (such as letting instructors know they needed help, etc.)." "Good discussion."
Incomplete sentences about my math ability	3	27.3	6	54.5	2	18.7	"Revealing." "Interesting." "Excellent. Loved thinking of ways to finish that in a POSITIVE way." "Excellent. I needed to hear myself and others out loud."
Force field analysis	6	54.6	4	36.4	1	9.1	Excellent! Good device and glad to have had a chance to use it." "We need to learn and practice from this."

"Sharing my anxieties with other women in a supportive setting."

Specific comments concerning dissatisfying aspects of the support group were as follows:

"Would like to have seen more continuity in membership, as well as more commitment to participating. I was very eager to explore this aspect of MY life and to learn about it, and about how others feel about it. Was sometimes dissappointed that others did not seem as enthusiastic as I felt."

"Time scheduled."

"As stated earlier the aggressive persons used the time not giving the nonaggressive ones equal time for discussion."

"First, didn't really relate much to math -- was more beneficial as a get-together experience -- something that does not happen in regular classes. Second, the leader did not confront one member who continually worked on text book during discussion and made completely irrelevant remarks."

"I did not like approach by instructor the first few sessions. Her statements that she was never anxious about math and it was all very easy for her were not reassuring to people who had problems."

"I just feel that my specific problem is taking tests and feeling confident. This will come through mastering the material itself. If I feel secure with the knowledge I know I will be able to cope with the tests."

The leader of the support group requested that two additional questions be included to solicit comments which were specifically directed at providing feedback to her. Their comments were as follows:

"She is very supportive and a good listener."

"Keep up the good work. You really relate to people and communicate exceptionally well."

"This was a well-planned, well-balanced learning experience for me. I got some important new insights about myself."

"I felt she was pleasant, positive, and organized."

"She seemed to really try. Seemed sincere."

"Sincerity in presentation and desire to help."

"She is young -- how experienced?"

"I feel the organization was okay, but seemed like members drifted off into other areas. Hard just to deal with math anxiety."

"I felt she was tactless the first few times I attended the sessions. Didn't have math anxiety so I dropped out. Would not consider taking a class she instructed."

"Never did send out list of names and addresses as you stated you would."

"A little natural confusion in how to go about setting up meaningful sessions."

Empirical Assessment of Effectiveness

Chapter III of the present report described, in detail, the results of each of the tests and questionnaires which were administered during the three-hour Diagnostic Clinic held in September of 1976. In addition to providing a comprehensive description of math anxiety and its correlates, two of the instruments, the MARS and the Arithmetic Placement Test, were re-administered to assess changes in math anxiety and arithmetic skills of those individuals who participated in various components of the Math Anxiety Program.

Seventy of the 71 participants in the Diagnostic Clinic completed the MARS in September 1976. A second copy of the MARS was sent in February 1977 to those participants along with the Diagnostic Clinic Evaluation Questionnaire. Forty-seven (67.1%) of the 70 participants returned their MARS's and 23 did not return the MARS. Because not all individuals returned the MARS, the question as to the representativeness of the complete data sets arose. Participants who completed the MARS at only the pre-test were compared with those who completed the MARS twice to determine differences between the two groups on initial MARS score. Results indicated that those who did not complete the MARS a second time had initially higher MARS scores than individuals who completed the MARS twice ($\bar{x}$ = 277.74, SD = 64.15 and $\bar{x}$ = 242.20, SD = 61.09. respectively; $t = -2.21$, $p \leq .05$).

The September 1976 and February 1977 MARS scores were compared for the 47 individuals who completed the MARS twice. The 47 individuals differed in terms of their involvement in the Math Anxiety Program: some participated in the Diagnostic Clinic, and some also participated in the support group. Comparisons between mean pre-test and post-test MARS scores, across the three "degree of involvement" groups, indicated significant lower math anxiety in February 1977 than in September 1976 ($\bar{x}$ = 210.11, SD = 64.11 versus $\bar{x}$ = 242.00, SD = 61.09 respectively; $t = 4.42$, $p \leq .001$).

If degree of involvement in the Program is positively related to greater decreases in math anxiety, one would hypothesize that the Program would be most effective in reducing math anxiety for those individuals who enrolled in a math class and also participated in the support group. Table 28 generally confirms this hypothesis. Although all three groups had lower anxiety scores in February 1977 than they did in the previous September, the greatest decrease in math anxiety was for those 11 individuals who participated in the Program to its fullest. The average decrease in the MARS score was approximately 75 points. By way of contrast, individuals who participated in only the Diagnostic Clinic had a decrease in math anxiety of approximately 14 points. Results contained in Table 28 indicate that individuals who enrolled in the course but not in the support group, tended to have relatively low MARS scores at the initial testing, but they, too, were less anxious in February 1977 than they were the previous September.

Similar analyses were performed for the Arithmetic Placement Test to compare the effectiveness of the Math Anxiety Program in increasing math skills of those individuals who enroll in courses. Because of the relatively small numbers of participants in GC 1445: Intermediate Algebra and Math 1111: College Algebra and Analytic Geometry, and the inappropriateness of the Arithmetic Placement Test for measuring change (i.e., ceilng effect and test content), the analysis

Table 28

A Comparison between Pre-Intervention and Post-Intervention MARS Scores, by Group

Group	September 1976 $\bar{x}$	September 1976 SD	February 1977 $\bar{x}$	February 1977 SD	t-value
No Intervention (N = 28)	248.71	58.16	234.39	66.88	2.17*
Course Only (N = 8)	207.12	60.27	169.87	46.29	2.60*
Course and Support Group (N = 11)	251.18	65.56	177.54	34.91	3.78**
	F = 1.64		F = 6.11**		

*$p \leq .05$

**$p \leq .01$

of changes in arithmetic skills was limited to participants in the Diagnostic Clinic who subsequently enrolled in and completed Arithmetic and Elementary Algebra. A second copy of the Arithmetic Placement Test was sent to those individuals; 12 participants returned their completed questionnaires.

Table 29 contains a description of mean test scores for the total group of 71 participants in the Diagnostic Clinic as well as the comparisons between September 1976 and February 1977 scores for those individuals who completed Arithmetic and Elementary Algebra. As Table 29 suggests, individuals who enrolled in the course tended to have lower initial scores than other participants in the Diagnostic Clinic who enrolled in one of the two more advanced courses and/or other participants who did not enroll in any of the courses. But the results also indicated significantly higher total scores in February 1977 than in September 1976 (61 versus 37, for a 68-item test). Analysis of changes for the 13 subtests indicated significantly higher ($p \leq .05$) post-test scores for 10 of the subtests. The greatest change was for "Properties of Numbers," Ratios, Rates, and Proportions," and "Problem Solving" items.

Did participants in the support group have any impact on math skills as measured by the Arithmetic Placement Test. Table 30 contains mean scores for individuals who enrolled in only the course versus individuals who enrolled in the course and the support group. Both groups increased their performances significantly; there was no indication that the support group added to the courses' impact on improving math performance.

Table 29

A Comparison of Pre-Course and Post-Course Arithmetic Scores

ale	Diagnostic Clinic (N = 71)		Course Completers (N = 12) September 1976		Course Completers (N = 12) February 1977		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	t-value
ithmetic Total	46.00	13.74	36.66	6.88	61.41	3.42	-13.84***
dition and Subtraction of Whole Numbers (4)	3.69	.55	3.50	.80	4.00	--	-- [a]
ltiplication of Whole Numbers (4)	3.49	.68	2.75	1.06	3.92	.29	- 3.92**
dition and Subtraction of Decimals (4)	3.30	.89	2.83	.84	3.75	.45	- 4.00**
vision of Whole Numbers (5)	2.70	1.18	1.50	.67	3.75	.97	- 6.85***
aning of Fractions and Rational Numbers (6)	4.49	1.46	4.00	1.28	5.25	.75	- 3.80**
l:iplication and Division of Decimals (6)	4.41	1.64	2.67	2.27	5.58	.52	- 4.16**
oblem Solving (6)	3.54	1.73	1.67	1.97	5.83	.39	- 7.60***
tios, Rates, and Proportions (6)	3.97	1.50	2.67	1.30	5.75	.45	- 7.75***
aning of Decimals (5)	4.40	.87	4.42	.67	4.67	.49	- 1.00
dition and Subtraction of Rational Numbers (7)	4.93	1.75	4.42	.99	6.58	.67	- 4.91***
ltiplication and Division of Rational Numbers (5)	3.27	1.32	2.58	.99	3.92	1.08	- 3.75**
operties of Numbers (6)	3.29	1.74	1.83	1.19	4.50	1.45	- 8.00***
rcentages (4)	3.07	.96	1.83	1.64	4.00	--	--

[a] Statistical comparisons were not appropriate in the absence of response variability

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

Table 30

A Comparison of Pre-Course and Post-Course Arithmetic Scores: Course versus Course and Support Group

Scale	Course Only (N = 5)					Course and Support (N = 7)				
	Pre		Post			Pre		Post		
	$\bar{x}$	SD	$\bar{x}$	SD	t-value	$\bar{x}$	SD	$\bar{x}$	SD	t-value
Arithmetic Total	41.60	4.83	62.80	2.78	-18.31***	33.14	6.04	60.43	3.69	-10.43***
Addition and Subtraction of Whole Numbers (4)	4.00	--	4.00	--	-- [a]	3.14	.90	4.00	--	-- [a]
Multiplication of Whole Numbers (4)	2.80	.84	3.80	.45	- 3.16*	2.71	1.25	4.00	--	-- [a]
Addition and Subtraction of Decimals (4)	2.80	.84	3.60	.55	- 4.00*	2.86	.90	3.86	.38	- 2.65*
Division of Whole Numbers (5)	1.80	.45	4.00	--	-- [a]	1.29	.76	3.57	1.27	- 4.04**
Meaning of Fractions and Rational Numbers (6)	4.60	1.14	5.60	.55	- 1.41	3.57	1.27	5.00	.82	- 4.80**
Multiplication and Division of Decimals (6)	5.00	.71	5.40	.55	- 1.00	1.00	1.15	5.71	.49	-11.21***
Problem Solving (6)	1.00	1.00	5.80	.45	-12.83***	2.14	2.41	5.86	.38	- 4.16**
Ratios, Rates, and Proportions (6)	2.80	1.10	5.60	.55	- 7.48**	2.57	1.51	5.86	.38	- 5.10**
Meaning of Decimals (5)	4.60	.55	4.80	.45	- 1.00	4.29	.76	4.57	.54	- .68
Addition and Subtraction of Rational Numbers (7)	4.60	.89	6.40	.89	- 2.45	4.29	1.11	6.71	.49	- 4.25**
Multiplication and Division of Rational Numbers (5)	2.60	1.34	4.40	.89	- 3.09*	2.57	.79	3.57	1.13	- 2.29
Properties of Numbers (6)	2.00	.71	5.40	.89	13.88***	1.71	1.50	3.86	1.46	4.67**
Percentages (4)	3.00	1.73	4.00	--	-- [a]	1.00	--	4.00	--	-- [a]

[a] Statistical comparisons were not appropriate in the absence of response variability

* $p \leq .05$

** $p \leq .01$

*** $p \leq .001$

CHAPTER V

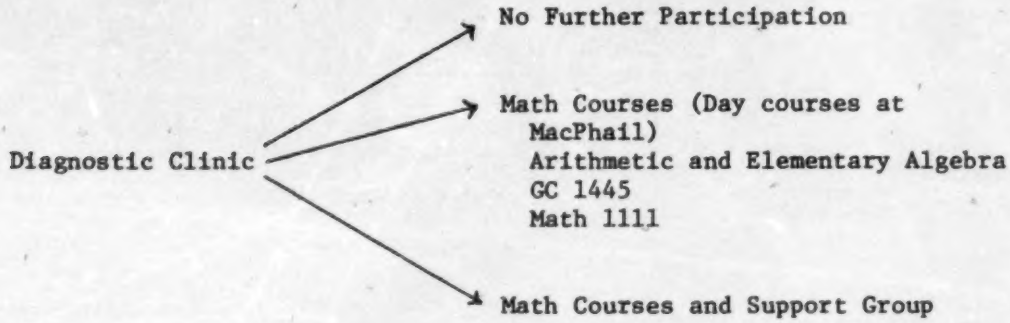
DISCUSSION AND CONCLUSIONS

Extensive evaluative data were collected from approximately 70 participants in the Fall semester 1976-77 component of the Math Anxiety Program. Results indicated that the Program had an impact in terms of decreasing the "math anxiety" of participants and increasing their math-related skills. And their direct evaluations of the three major components of the Program (i.e., the Diagnostic Clinic, the three math classes, and the support group) were quite positive in their support of the Program. The Program was offered a second time during Spring semester; another 18 individuals participated in the Diagnostic Clinic and approximately 35 individuals attended an evening Diagnostic Clinic, jointly sponsored by Continuing Education for Women and Continuing Education and Extension. Although some evaluative data are being collected from these individuals, the evaluative component was not emphasized as strongly as for the Fall semester participants. Informal descriptions of these results will be available from Program staff.

Evaluative data from participants supported the need for a math anxiety program and suggested that the Program had been successful in meeting its primary objectives. Continuing to offer something analogous to the Program described in the first chapter of this report seems to be supported by the data. But several modifications in the Program seem necessary to facilitate the smooth operation of the Program on a regular basis and other issues (e.g., the need for the Program to be self supporting) need to be addressed.

A theme which emerged from participants' evaluations of the Program is a need for flexibility in terms of the three major components of the Program (i.e., the Diagnostic Clinic, the math courses, and the support group). The Program during Fall semester was designed so that individuals who participated

in the initial Diagnostic Clinic had the following "next step" options for dealing with their math anxiety and/or improving their math skills:



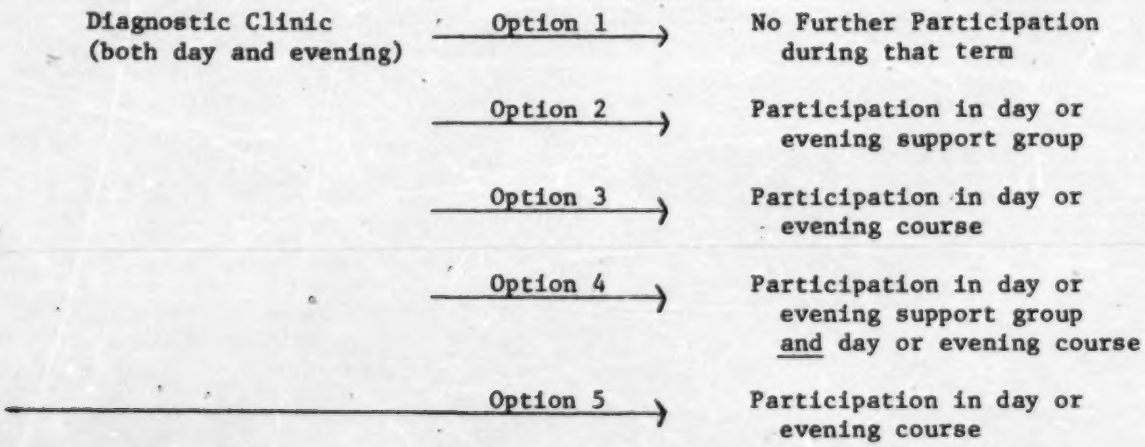
No individuals who were not currently in a math course were allowed to participate in the support group and all those who wished to participate in the support group had to have attended the Diagnostic Clinic. And individuals could register for courses without any real involvement in other components of the Program. Although it makes some pedagogical sense to restrict course registration to those who attend the Diagnostic Clinic, doing so would reduce the number of course registrants and undermine the fiscal viability of the Program which needs to be self-supporting. Perhaps it is necessary, however, for instructors to be sensitive to the possible differing needs and entry-level competencies of the two subgroups of students: the "math anxious" students and the students who do not label themselves as being "anxious about math." Examination of the expectations of those who attended the Diagnostic Clinic revealed a large variation in responses: some wanted only to know "where do I start" and had little math anxiety and others had avoided "math all their lives" and expected the Program would help them overcome this fear of math.

Not permitting individuals to participate in the support group unless they were also enrolled in a math class was based on the assumption that dealing effectively with math anxiety involved two components: dealing with

affective issues by small group discussion and experiential activities and by actively confronting math by being in a class. Data concerning math anxiety indicated that, indeed, the greatest changes in reducing math anxiety occurred for those individuals who took a course and participated in the support group but there were no data for individuals who attended only the support group. How great an impact on math anxiety would attending only a support group have? Permitting individuals to participate in only the support group, however, does not mean that participants should feel free to continue to avoid math. Non-course math activities could become "support group homework".

Flexibility in terms of which courses were offered and when (i.e, day versus evening) was a related issue. Participants indicated an interest in taking those math courses which are necessary pre-requisites for certain other courses and majors. But the number of individuals who enrolled in advanced courses was relatively small. Perhaps the crucial need is for a beginning level course which is flexible in terms of how the course may be taken (e.g., credit versus no-credit). A more crucial issue involved the need for special math courses to be offered at night, in addition to the Clinic and support group which were offered at night during Spring semester.

These considerations suggest the following model for the Math Anxiety Program:


Diagnostic Clinic
(both day and evening)
Option 1
No Further Participation during that term
Option 2
Participation in day or evening support group
Option 3
Participation in day or evening course
Option 4
Participation in day or evening support group and day or evening course
Option 5
Participation in day or evening course

The only restriction in this model is that individuals may not participate in the support group without previous attendance of a Diagnostic Clinic.

Another theme which emerged from participants' evaluations and from evaluations of those involved with the Program was the need for timeliness in providing appropriate feedback to participants and greater efficiency in Program implementation. Many of the inefficiencies are inevitable when a new program begins and most of those inefficiencies are no longer problems now that procedures have been developed which can be used routinely in the future. Participants in the Diagnostic Clinic must receive a detailed letter describing their test results within a week so as to allow them sufficient time to choose one of the options described on the previous page.

Some changes in the Diagnostic Clinic emerged as suggestions for consideration. Although the three-hour session was a bit too short (participants felt hurried), expanding the length without a break seems unreasonably long. A 3 1/2 hour Diagnostic Clinic with a short break was suggested. Other recommendations were as follows: 1) provide more information concerning the Program and how it works (i.e., options for participation); 2) emphasize the testing of math skills and de-emphasize extensive testing of anxiety dimensions; and 3) allow time for introduction of instructors and provide an opportunity to talk with them individually. Which math tests should be used in future Diagnostic Clinics is an important issue which also needs to be resolved.

Evaluative data concerning the three math courses were quite uniform and very favorable. Other than some minor suggestions, few changes in the content and/or instructional techniques seem necessary. One caution emerged concerning the need for those who enroll in math courses to be aware of the time commitment that they will have to make in terms of course homework. Several individuals

noted that the major problem with the course was that they did not expect to spend so much time on the course which meant that some of them "got behind" and eventually dropped the course. For these participants, enrolling in a math class became another negative experience with math. Developing realistic time expectations seems desirable prior to enrolling in a math course. The same issue, the need to be committed to dealing with math anxiety, emerged from an examination of evaluative information concerning the support group.

Individuals who participated in the Diagnsotic Clinic completed an extensive battery of instruments which were selected to obtain a comprehensive description of the "mathaphobic person". Much of that information was used by the Program coordinator in describing who participated in the Program and by the support group counselor to develop appropriate intervention techniques for dealing with math anxiety. Those results, described in detail in Chapter III of the present report, suggested the following: 1) math anxiety is not an isolated anxiety, but is highly related to being anxious about tests and being anxious in situations in which being evlauated negatively is possible; 2) compared to normative groups described in Richardson and Suinn (1972), participants in the Math Anxiety Program, were, as a group, considerably more anxious about math; and 3) a few factors emerged which could explain how math anxiety develops and why it seems to occur more frequently among women than men.

Planning is currently underway to determine the format for the Math Anxiety Program during 1977-78. Several issues should be considered in that planning process: 1) the need to develop accurate expectations on the part of participants; 2) the need for earlier advertisement of the Program and its three major components so that those who are in need of the Program can choose to participate and so that sufficient numbers enroll so that the Program can be self-supporting; 3) the need to streamline procedures so that the Program is simple

to coordinate and involves a minimal amount of time to coordinate; 4) the role which continued research and evaluation should have (e.g, whether to use the Fennema-Sherman math attitutes scales and/or administer a general anxiety scale); 5) the need to find an appropriate procedure for measuring math ability which serves the dual purpose of diagnosis and placement; and 6) how the Math Anxiety Program might be able to expand its model to other populations of math anxious students at the University.

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Continuing Education and Extension

APPENDIX A

UNIVERSITY OF MINNESOTA
Continuing Education for Women
200 Wesbrook Hall
Minneapolis, Minnesota 55455

September 15, 1976

Dear

We are writing to you to describe the results of the tests you took at the Math Anxiety Program Diagnostic Clinic and to make some general suggestions concerning how you might "begin-again" your instruction in mathematics.

All participants in the Diagnostic Clinic completed the 68-item Arithmetic Placement Test. Tests were scored during the session to determine if you should take a more advanced test, the Algebra Placement Test. Individuals who had scores of 48 or above were given a copy of the second test to complete at home and return to the Measurement Services Center for scoring.

Your score on the Arithmetic Placement Test was ____ which means that you answered correctly that many of the 68 items. Scores of the participants in the Diagnostic Clinic varied widely; the highest score was 67! Many of you probably did better than you expected and some of you probably did worse than you expected.

The average score (i.e., sum of all the scores divided by total number of participants) for the class was 45.8. The "median score" (i.e., the score which was the middle score for the group) was 47. If you scored higher than 47, you were in the "upper half" of the participants and if you scored lower than 47, you were in the "lower half" of the participants. Participants who scored 56 or higher were in the upper 25% of the group and participants who scored 64 or higher were in the upper 10% of the group!

The 68-item Arithmetic Placement Test contained different types of items such as multiplication, fractions, and decimals. Your scores for each of 13 different types of items were obtained to determine areas of arithmetic in which you are strong and areas in which you are weak.

The following information describes the highest possible score for each set of items, the passing score for that set of items (i.e., approximately 70% or more of the items correct), and your score for each of the 13 different types of items. If you scored at or above the passing score for the set of items, consider that you "passed the test" for that type of item. If you scored less than the passing score, results suggest that you may need some review for that type of item or that you may not have been careful enough in doing your calculations.

	Highest Possible Score	Passing Score	Your Score
AR-2: Addition and Subtraction of Whole Numbers	4	3	____
AR-3: Multiplication of Whole Numbers	4	3	____
AR-4: Division of Whole Numbers	4	3	____
AR-5: Properties of Numbers	5	4	____
AR-6: Meaning of Fractions and Rational Numbers	6	4	____
AR-7: Addition and Subtraction of Rational Numbers	6	4	____
AR-8: Multiplication and Division of Rational Numbers	6	4	____
AR-9: Meaning of Decimals	6	4	____
AR-10: Addition and Subtraction of Decimals	5	4	____
AR-11: Multiplication and Division of Decimals	7	5	____
AR-12: Ratios, Rates and Proportions	5	4	____
AR-13: Percentages	6	4	____
AR-14: Problem Solving	4	3	____

You might also be interested to know how the group as a whole did for the various types of items. The following list is a "rank ordered" description of those areas in which the group was strongest and areas in which the group was weakest (i.e., 1 = strongest and 13 = weakest.)

Rank	Item Type
1	Addition and Subtraction of Whole Numbers
2	Multiplication of Whole Numbers
3	Addition and Subtraction of Decimals
4	Division of Whole Numbers
5	Meaning of Fractions and Rational Numbers
6	Multiplication and Division of Decimals
7	Problem Solving
8	Ratios, Rates, and Proportions
9	Meaning of Decimals
10	Addition and Subtraction of Rational Numbers
11	Multiplication and Division of Rational Numbers
12	Properties of Numbers
13	Percentages

All participants in the Diagnostic Clinic also completed four anxiety questionnaires. Results of those questionnaires will be discussed in the Support Group portion of the Math Anxiety Program. For you who do not participate in the Support Group, we will write you another letter later in the Fall to describe the results of those questionnaires.

You were one of the individuals who completed the 50-item Algebra Placement Test which was much more advanced and difficult in content than the Arithmetic Placement Test. You answered correctly ____ of the 50 items. Scores of the individuals who took this test varied widely; the highest score was 42. The average score (i.e., the sum of all scores divided by number of participants) for the class was 23.8. The "median score" (i.e., the score which was the middle score for the group) was 23. If you scored 29 or above, you were in the upper 25%.

We have examined carefully your test results and your preference for continuing your math education (i.e., whether you thought you should enroll in Arithmetic and Elementary Algebra, GC 1445: Intermediate Algebra, or Math 1111: College Algebra and Analytic Geometry). Where you think you should begin and where the test results indicate you should begin were the same. That is, if you continue in the Math Anxiety Program, you should enroll in _____. If you plan to do so, we would like to outline the specific procedures you should follow to enroll in the course.

It is important that you register for the math class you wish to take as soon as possible. All registrations must be received by Wednesday, September 22nd. Enclosed is detailed information about the three math classes being offered this fall and a registration form. You may return the completed form to Continuing Education for Women by mail or in person.

For those interested in participating in the support group and tutorial services, there is no additional fee or registration required. Tutorial services will be available Friday mornings at MacPhail beginning October 1. The Math Anxiety Support Group will meet for the first time Wednesday, September 29, 11:00-12:30 at MacPhail.

We hope you find this program most satisfying. Please feel free to contact us if you have any questions.

Sincerely,

Margie Mathison
Program Coordinator

Enclosures

MM/psa

Continuing Education and Extension

UNIVERSITY OF MINNESOTA

Continuing Education for Women
200 Wesbrook Hall
Minneapolis, Minnesota 55455

APPENDIX B

March 11, 1977

Dear Diagnostic Clinic Participant,

You participated in the three-hour Diagnostic Clinic held on January 13th as part of the Math Anxiety Program offered through Continuing Education for Women. I am sorry that there has been such a delay in getting the results of your testing to you. We have made changes in the test interpretation that have been time consuming but which we hope you will find beneficial. The following information will describe the general results of that testing session and summarize the implications of that information for your continuing education in mathematics. (For those who attended the Diagnostic Clinic and participated in the Support Group, results of the Clinic were discussed during one of the sessions of the Support Group.)

You'll remember that we discussed various aspects of math and math anxiety and how being anxious about doing math can interfere with your performance on math tests. One of the questionnaires you completed was the Mathematics Anxiety Rating Scale (MARS), developed by Richard M. Suinn at the University of Colorado.

The MARS contains 94 items dealing with various aspects of math and how anxious you feel about doing math in different situations. Your "total anxiety score" could range from a low of 35 (indicating that you marked "not at all frightened" for each of the 94 items) to a high of 470 (indicating that you marked "very much frightened" for each of the items.)

We held two separate Diagnostic Clinics in January - - a Day Clinic and an Evening Clinic. The average score for the 17 participants in the Day Clinic was 254.8 and the average score for the 40 participants in the Evening Clinic was 275.6. (Data from a comparable group of 70 participants in a comparable Day Clinic during September, 1976 through Continuing Education for Women indicated an average score of 253.9).

Individuals who participated in the Support Group component of the Math Anxiety Program tended to have more anxiety about mathematics than those of you who participated in the Diagnostic Clinic only. Hopefully, one of the effects of participating in the Support Group is a lowering of individual's feelings of anxiety in dealing with mathematics.

Your score on the MARS was _____. You may wish to compare your score with the average score to determine whether you are more or less anxious (i.e. above or below the average score) for people in your group.

If you scored 188 or below, it does not seem that math anxiety is a major problem for you. We would encourage you to continue your "math re-education" by completing a math ability test to see at which point (e.g. arithmetic, elementary algebra, college algebra, etc.) you should consider re-entering instruction in math. Tom Ressler, instructor in the Math program, has information about where and how to arrange to take the math tests. He can be reached at 373-3708.

If you scored 282 or above, it seems likely that being anxious about doing math may be interfering with your actual math performance. If you have not already done so, we would like to encourage you to enroll in a Support Group which has been designed to help people like you overcome their fears about math. If you are interested in participating in a support group in the future, please call me for further information.

You may be interested in how those who attended the Diagnostic Clinic responded to the various 94 items on the MARS. The eight items which were most likely to elicit fear were the following:

1. Signing up for a course in Statistics.
2. Taking the math section of a college entrance exam.
3. Reading a formula in chemistry.
4. Taking an examination (final) in a math course.
5. Hearing a friend try to teach you a math procedure and finding that you cannot understand what he is telling you.
6. Being given a homework assignment of many difficult problems which is due the next class meeting.
7. Talking to someone in your class who does well about a problem and not being able to understand what he is explaining.
8. Not knowing the formula needed to solve a particular problem.

You'll probably remember that you completed two other questionnaires (the Sentence Completion Questionnaire and Diagnostic Clinic Questionnaire) during the three hour Diagnostic Clinic. We hope that you found completing those questionnaires to be a beneficial self-awareness exercise for you and that doing so has given you some insights concerning math anxiety and how it may have developed in your life. You answered many questions about your previous educating and experiences in math and your attitudes about those experiences. We have read through your questionnaires and are highlighting information that has the greatest impact on your math ability:

We hope that this information has been useful to you. Enclosed is a copy of a "Math Anxiety Bill of Rights" developed after reading participants' responses to the two questionnaires. Please call me at 373-9743 if you have any questions about what step you might consider next in becoming more competent and comfortable with math.

Sincerely,

Margie Mathison

Margie Mathison
Program Director

MM/ss

Enclosures

APPENDIX C

Math Anxiety -- Diagnostic Clinic, Question 6

001. "Not sure I'll participate in support group. I took the test to determine whether I should review advanced algebra first or go right into college algebra."
"Complete college algebra with B or A."
"Determine whether I sould also take trigonometry and/or analytical geometry."

002. "I want to get into an MA program in Communication Disorders. To this end I am attempting to complete a BA in CDis this year. As of September 27th I start a class in Acoustics which I've found I need a lot more math than I have."
"Brush up on algebra."
"Learn logarithms."

003. "Math has always been enjoyable to me, and more success than other fields. Now in middle age I want to return to education that was interrupted, but on a scale that will not take precedence over family."
"Wake up a sleeping brain."
"Finish math courses that will relate to problem solving in life."
"Equip me for a certain degree of understanding business math."

004. "I know I'm not dumb, that I lack the tools to understand how to solve math problems. Call it motivation or whatever. I want to acquire the tools to enable me to think, without panicing and I know I can do basic math after completing this class."
"Solving simple things like adjusting recipes (everyday living)."
"Getting better job."
"Self confidence."

005. "To overcome as many math problems I have to become better equipped in my job."
"To become more at ease with numbers."
"Feel better about myself."

006. "Would like to know where I fit in Y or Extension Math classes in order to prepare for degree program."

007. "I want to learn the very basics of math that I was unable to grasp during my school years. Learning math will eliminate the constant fear and apprehension assocated with math and numbers."
"Learn the basics."
"Be at ease working with numbers."
"Eliminate fear in testing situation."

008. "To determine whether math is something I'm just not capable of doing -- or is there a potential for learning.
"Improve skills."
"Want to stop counting on my fingers!"
"Gain self confidence."
"Metric system conversion."

Math Anxiety -- Diagnostic Clinic, Question 6

009. "I've always wanted to go further into math; I enjoy math but as a high school student did not have enough confidence to to on. Furthering my math background will open new doors as far as educational opportunities."
"Master's Degree."
"Para-legal administrator."
"Law school."

010. "To learn more about math."
"To overcome my hangups."
"To increase my knowledge of math."
"To be less anxious about it."

011. "I have math requirements in my degree program -- I failed 1411 and have dropped out of two other math classes (1201 and Calculus)."
"To see if I really have an anxiety problem (I think it's really poor lack of background."
"To see where I should be placed."
"To begin conquering my problems."

012. "Always had a fear of math since was a new student in a new school at the 4th grade level, had to stand up with a pointer and give answers to problems on blackboard. This was timed and all students watched. I must get over an inadequate feeling towards math."
"Become more confident in a public situation."
"Enjoy math and card games in a social circle."

013. "To be able to take other math courses."
"See how good/bad I am."
"Improve my abilities."
"Eliminate my fear."

014. "I feel a challenge to overcome my feelings of failure in the area of mathematics and had several traumatic, uncomforatable years in high school, becuase I was placed in classes above my level. I would like to go back to master this area."
"Gain conficence in myself in this area."
"Complete class so I can go onto more difficult classes."
"Take Advanced Algebra to get into Home Ec Department."

015. "To find out if I have any aptitude with math. In my past working experience I enjoyed bookkeeping and I would like to further my education there if I can overcome the fear of math. Also to get started studying again after 8 years in a class where the pressure is less than a regular class at the U."
"Learn to study and concentrate."
"Do something well and receive the satisfaction."
"Overcome the fear of math."

Math Anxiety -- Diagnostic Clinic, Question 6

016. "See if necessary need to take first year algebra."
"Know my deficiencies in math."
"Know which math program to begin."

017. "Because I got as far as flunking first year algebra in high school and did not go on from there. I want to know math.
"Better checkbook managaement."
"Participation in investments."
"Conversing with children in their math discussions."

018. "I am enrolling because I feel I had an extremely poor background in math."
"Develop skills for my own enjoyment."
"Place well on GRE."
"Understand statistics."

019. "To better find out exactly what math or algebra course to take next in CEW."
"Take college math for credit."
"Discipline my mind."
"Create more alternatives."

020. "I hope to gain enough knowledge of math to be accepted into and succeed in a graduate business degree program."
"Ability to earn score of 450 on Graduate Management Admission Test."
"Feeling of confidence in math."
"Understanding of mathematical principles."

021. "I feel my skils and understandings are very poor. I would like to improve my performance as a council person as well as manage my own financial future to a greater degree. I am hoping to return to graduate school within the next 2 years."

022. "For math background for other College Courses, i,e., Chemistry and Econimics."
"Ability to handle basic math, everyday life situations."
"General self confidence to rid myself of present math 'block'."

023. "One is self fulfillment. I am planning on taking an accounting class this fall and hope to do my husband's books in his real estate firm. I want to handle the company if the need arises."
"Be classified as an accountant."
"Get real estate license."
"Figure math in my head -- quickly."

Math Anxiety -- Diagnostic Clinic, Question 6

024. "I know that math anxiety is one factor that will be a determinant of what I choose to do about future educational options and am using this clinic as one source of information concerning that decision -- If I do enroll."
"Reviewing forgotten material."
"Re-establish competencies lost through non-use."
"Develop a less anxious attitude towards mathematics."

025. "Math has frightened me since grade school. I personally would like to overcome this. Also I have become interested in computers and would like to take some software courses for which you need a heavy math background."
"To overcome my fear."
"To improve my skills."

026. "I am enrolling because of a real fear of numbers."
"To be able to do simple math in front of others without fear."
"To be able to take courses that involve math."
"To get rid of the block."

027. "To better identify which level of math I should begin at after having no formal math for over 15 years."
"Better understanding of many basic operations which I now do mechanically but without understanding."
"Preparation for calculus courses."
"Preparation for statistics courses."

028. "I feel my math abilities are at the most rudimentary level. I know I am of normal intelligence and do quite well in other areas -- and I ask myself -- why do I do so poorly in math?"
"To know how to do every problem in the test."
"To at least have an 8th grade competence in math."
"To relieve my anxiety in situations in everyday life where simple computations and math are involved."

029. "I may want to try for graduate school in social work. I would have to take statistics and I cannot. I am also considering going into real estate and I need good math skills."
"Be able to take college level statistics."
"Be able to compute interest, compound interest."
"Be more comfortable with myself vis a vis numbers."

030. "To add to my knowledge of math. To enable me to take courses at U of M which are presently beyond me because of lack of math background. To work towards a degree and use math in life situations. I enrolled because I felt the gap in my knowledge."

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031. "Math has always been my worst subject. I know I'll have to take math courses, so I want to improve my math attitude so I'll enjoy these classes as much as is feasible."
"More positive attitude.
"Better math skills."
"Confidence in my math ability."

032. "I wish to work comfortably and easily with problems presented in math language as I want to pursue and obtain a degree in Business Finance. Most finance courses are presented in math language."
"Proceed through beginning algebra."
"Obtain degree in Business Finance."
"Proceed to other degrees."

033. "To determine my placement regarding math knowledge."
"To begin math requirements at higest level class for which I would qualify."
"To be comfortable with math skills necessary for BA degree and graduate work."

034. "First I want to know if there really is no hope of ridding me of the blocks I've put up. I have had several career opportunities, but upon investigation, I say 'yuck, numbers -- I can't relate to that'."
"To rid myself of the block I've set up."
"To find out what my aptitude really is."
"To feel confident in my new knowledge."

035. "I want to learn math to be proficient enough to go to more school."

036. "To find my weaknesses."
"Up grade my abilities to enroll in U of M math classes."
"Have more confidence in my ability."
"Enroll in second accounting class and need this refresher on basic math."

037. "I would like to take a chemistry course and don't have enough math to handle it. I've only had one year of high school algebra and I don't remember any of it."
"Review high school algebra."
"Study enough advanced algebra and other advanced courses in math to handle a chemistry course."

038. "I want to overcome my math anxiety.
"Complete intermediate algebra."
"Complete math 1111 -- college algebra and analytical geometry."
"Know if I am able and willing to continue with still more math."

039. "Becuase I feel I have always had a mental block in this area which I am handicapped by in every area of living."
"Less tension when faced with math problems."
"Better ability in taking tests required to land jobs as well as in job situations requiring figuring."
"Better general understanding of role of math as it pertains to science."

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040. "Enrolling to review math skills I do have and to learn algebra. Have had algebra before and never understood it -- would like to finally do that. Would also like to have the feeling that I can use math skills well whenever I need to do so. Like to "get over" my fear of this -- it's a challenge."
"Be able to take a statistics course or economics."
"Do reasonably well on math portion of Graduate Record Exam."
"Have better confidence in everyday math skills used for price comparison, budgets, etc."

041. "To find out where I need to start to work at getting better to improve myself image and to help me in my job."
"Self Image."
"Growth."
"Job."

042. "I feel a real lack of mathmatical knowledge and I feel this program will pinpoint my weakest areas so that I can build a strong foundation of understanding and then go on if I wish."
"Evaluation of present status."
"Fill in gaps in math."
"Learn new things."

043. "I have trouble with anything dealing in computation or simple arithmetic -- I work very slowly. I have no math background other than freshman high school algebra and I cheated my way through that."
"To understand math and simple algebra."
"To be able to work out math problems on my own."
"To feel reasonably sure that my answers of above are correct."

044. "I need the equivalent of 4 years high school mathematics to deal with the science courses I have to take."
"Bring myself up to needed level of 4 years high school math."
"Become confident and willing to approach new material."
"Understand as well as possible the scope of higher mathematics as well as be able to work problems."

045. "To brush up."
"To know more about math."
"To learn new problems I never had."
"To possibly figure income tax and bookkeeping."

046. "To face an old problem -- dealing with numbers. To enable myself to function better and more indpendently in society."
"To increase my skills."
"To increase my employability."
"To develop an underdeveloped area of myself."

047. "Find out where I am at in math."
"Must have three quarters of calculus for my major."

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048. "Principle reason is to upgrade math skills in order to fulfill prerequisites of business or accounting program at U of M.
"Reach college algebra level of competence."
"Achieve greater ability in numerical spacial approaches to math."
"Restore confidence in ability to handle higher level mathematical concepts."

049. "To overcome anxiety and be able to discuss the economy and percentages in business etc."
"To work out problems."
"To add, subtract, and multiply fractions."
"To work with percentages."

050. "I am considering going to law school and need to feel confident in my mathematical ability before applying."
"To understand algebra."
"To understand geometry and statistics."
"To understand baisc quantitative analysis."

051. "I have a BA in Urban Studies but I want a more marketable degree in Business Administration to get a better job. I feel my math background is too poor to go on for a master's, and that I need to groom myself well to get a BS in Bus. Admin."
"Complete all math courses required for entry into Bus. Admin."

052. "I have taken lifetime fear of math. It has affected many aspects of my life. I have always felt if I could understand and take math courses I would have the confidence to puruse other areas I'm also interested in."
"Understanding of basic math -- why you do things."
"Overcome my feelings that I can't comprehend."
"Relax and appreciate the fun and beauty of numbers."

053. "To measure my math skills."
"Understand math terms."
"Fulfill math requriements."
"Degree in Business Administration."

054. "To be able to take statistics."
"Pass basic math."
"Pass algebra I and II."
"Pass statistics for my masters in FSOS (Human Sexuality)."

055. "Self improvement."
"To be able to communicate with son in college at a comparable level."

056. "I am interested in obtaining a BS in Bus. Ad. and possibly an MBA. A couple courses in math are required and are prerequisites for several business courses. I feel this program will help me through completing these requirements."
"To feel confident when asked to compute."
"To improve my ability to calculate under pressure."
"To gain a better understanding of the funadamentals -- the why's and how's of math."

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057. "I want to enroll in math classes to earn my degree and I want to be able to shed the fear I have for math. Also, I know I can learn, thus my confidence would be boosted. Then I'm sure I wouldn't be so negative about my abilities."
"Quit being so afraid of math."
"Get rid of my mental block so I can learn.

058. "Since I feel some lack in math, I want to have the evaluation so that I can do some advance planning before I work on some additional research."
"Take remedial math for some ego building."
"Have more budget responsibility."
"Have a new career opportunity."

059. "Personal satisfaction, build confidence in my ability. Also to gain background for courses in which I'll need math (Chem., Physics). I am planning on going into nursing after graduation this year -- need math for science courses."
"Confidence in my ability."
"Background for more math and Science."
"A better attitude toward math."

060. "I enrolled to determine whether I am capable of learning basic math (learn fractions, learn algebra, gain math confidence) and if so, to practice it -- if it's not too boring."
"Overcome math anxiety."
"Increase ability to reason through problems."
"Learn fractions and algebra."

061. "I feel a mental block about math (even thinking about math) and hope to dispel the feeling of panic when confronting even simple problems, gain some confidence in dealing with anxiety and ability to do and understand simple problems."
"Overcome anxiety."
"Learn math basics.
"Confidence to attack new goals."

062. "I might want to major in Business or Biology."
"To be capable enough mathematically to major in a science."

063. "Need to know where I stand mathematically, how I can correct the problems and rid myself of anxiety in college courses especially math.
"Better math skills."
"Technique to understanding weaknesses."
"Technique to improve."

064. "I am interested in a graduate program that involved advanced work in statistics. I need to re-enter the math field and gain confidence."
"Learn to work with equations."
"Learn to work with functions."
"Learn to work with probabilities."

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066. "Feel a definite lack of basic math skills which have always been a source of embarrassment to me in life situations. I really want to know if it was my conditioning or a natural lack of ability. I want to get into the job market in the near future and know I'll need skills, I am now responsible for my household finances as I am now single and have my own private funds to manage."

067. "To find out if my math is as bad as I thought it was at what point I get stuck in that subject."
"Evaluate ability to take market research major."
"Take market resarch major."
"Use more math in job -- thus, a better job."

068. "As I was skipped in grade school, I missed some basic fundamentals in math so I cannot do some percents and fractions at all and some other problems with ease."
"Do fractions."
"Do percents."
"Do math problems easily."

069. "To learn how to do math and not be afraid of it. To be able to apply for a job or just plain figure everyday problems."
"Attain security, re: in math numbers."
"Obtain a better job."

070. "To get at the base of anxieties and to overcome fears or whatever is at the basis."
"Would like to get into a program education."
"Become proficient enough to qualifiy for further education.

071. "Interesed in improving abilities to help me at work."
"Reducing fear of numbers and being wrong."
"Being able to retain numbers for instant recall or longer periods."
"Relearning simple math skills."

072. "I feel I need to re-acquiant myself with math. I know there is a need for everyone to be better acquainted with it than I am."
"Find out where I should begin."
"Start taking courses to the point where I am at least familiar with algebra."